THE

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THE

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SMOKELESS COMBUSTION.

LAST week it was the turn of the Metropolitan Electric Supply Company, of St. Peter's Wharf, Amberley Road, Paddington, to be charged at the Metropolitan Police Court with the emission of black smoke from their works' chimney. While the company were compelled to generate electricity, there was nothing, said Mr. H. C. Byron, who prosecuted, which specified the coal they should use, and it was a question for the company to take the consequences of relying upon a smoke-producing coal if they chose to do so for economy. Then the magistrate asked why the energy could not be produced by gas engines, and Mr. Byron wisely exclaimed: "Exactly; there is no reason whatever," to which Mr. Spencer Bower replied for the defendants, "It is absolutely impossible." We feel glad we were not in Court to hear Mr. Byron's foolish remark. It is simply maddening to listen to the unpractical babble of technically unlettered counsel upon engineering subjects. They may know all about the Punic wars and give the date when Hannibal crossed the Alps, but of coal consumption they know nothing. Mr. Frank Bailey gave evidence on behalf of the company as managing director, and admitted that the furnaces were suitable only for Welsh coal, and stated that if the company had intended to use soft coal (bituminous), there would have been a chimney to each boiler, and careful stoking would make a deal of difference. We do not understand the allusion to the separate chimneys, and think Mr. Bailey must have been misreported. The magistrate finally held the company responsible, and gave them nine months in which to "build the necessary chimneys," which we take it means to amend the construction of the furnaces, so as to make them consume bituminous fuel without smoke. Any furnace will burn smokeless coal without smoke; this is a self evident truism. To burn bituminous coal is a compound operation. It requires more skill on the part of the fireman than is usually possessed by men accustomed to loading up Welsh. It demands also a special construction of furnace, and a carefully-regulated secondary admisson of air above the fire in order to afford oxygen to the hydrocarbon gases which so rapidly distil off each new charge of fuel. The ordinary water-tube boiler in its usual setting is hopeless as a smoke preventer. It cannot fail to smoke, but the Babcock & Wilcox Company have grappled with the difficulty, and have modified their boiler so as to admit of a setting which permits of the flow of gases and air admission similar to that possible in Lancashire boilers, and we have seen such a boiler,

even where the secondary air admission was hardly on the best lines, fired on the side-firing system, so as to be practically smokeless. Nor should the now classic Wigan coal trials be forgotten, which proved that in Lancashire boilers the very bituminous coals of Lancashire and Cheshire could be burned both smokelessly and economically. It is not easy to secure the economy, nor is smoke a sign necessarily of a wasteful use of coal. Black smoke is a fearful thing to gaze upon, but a very impalpable thing in itself. It is evidence that in the combustion of hydrocarbon gas certain particles of the gas have not been in contact with oxygen at a time when they were hot enough to combine with such oxygen. We may supply double and treble the air chemically necessary, yet smoke may result. The difficulty is to provide the air at the right time and place in sufficiently fine streams to thoroughly permeate the whole volume of gas, to do this at the right temperature for ignition, and to provide a space free from cooling agents in which combustion may complete itself. The usual setting of the ordinary water-tube boiler makes no attempt to fulfil any one of these functions. The Lancashire boiler is right in shape, but it fails, where and so far as it does fail, in having a water-cooled furnace; and often, through the desire of boiler makers to sell cross tubes at 40s. each, by having water pipes put across the flue tubes behind the bridge to effectively knock out any life from the struggling flames which burn past the bridge. We hardly wonder at steam users going in exclusively for Welsh coal. They have had but little encouragement from boiler makers to do otherwise, and too often when they do attempt to remedy the evil by trying experiments, the smoke inspectors attempt to get them fined for any smoke emitted during the experiments. We have known this done in Manchester, where of all places one would expect the smoke inspectors to have some technical knowledge and sufficient sense to know that every experiment cannot prove a success, nor can it be remedied if wrong usually before a Saturday. We are not sympathisers with the production of smoke, but we do think that manufacturers have usually plenty to worry them without being harried on the smoke question, and prosecuted with the aid of any kind of barrister who may be put up to fire off ill-digested statements in a police court.

It is due to the irrational prosecutions for smoke that so many have taken the weak course of using exclusively smokeless coal, in place of attempting to secure the economy of cheaper bituminous fuel.

Electricity Applied to Steam Railroads.

THAT a paper dealing with the above subject should have been presented to the Saratoga meeting of the American Master Mechanics' Association is in itself a sign of the times. A so-called master mechanic is what in England would be called a locomotive superintendent. His duty is to find the machines which draw the trains, and it appears probable that every day will see more of these machines electrically operated. For elevated lines, the author of the paper, Mr. D. W. Brangs, thinks electricity specially suitable—largely because of the facilities it offers for rapid service, some recent acceleration tests having shown a rapidity of acceleration 40 per cent. better than steam locomotives can possibly give. With standard railroad type of cars four 50-H.P. motors at 500 volts and 90 amperes, mounted two on each truck, geared down 33—52 to the axles, gave a speed of 30 miles per hour in 10 seconds. In five seconds after the controller switch had been moved a speed of 19 miles was secured, and so on, in 10 seconds 30 miles, 15 seconds 35 miles, 20 seconds 38, and 25 seconds 40½ miles per hour. This is very rapid acceleration indeed, an ordinary train rarely exceeding a speed of 10 miles per hour at the end of the first 10 seconds. On the Manhattan Elevated a speed of only 13½ miles was secured by steam in 20 seconds, during which the space covered was 198 feet, while the electric car had attained 38 miles velocity and travelled 356 feet in the same time. As there is no dynamic jerk at the start such rapid starts are not unpleasant. In the course of his paper the author described the system of control invented by Mr. F. J. Sprague, whereby each controller on the various cars of a train is operated by a little pilot motor from the driver's equipment, every car thus working as an independent unit in a connected train. Coupling stresses are thus reduced to a mere differential minimum. The multiple unit system is thus applicable to trains of any length. The author also described the system of pick up from the third rail. This is simply a cast-iron shoe of 15 or 20 lbs. which is dragged along the rail and lasts about a year. To show what electricity can do he quoted the daily 800 passengers between New Britain and Hartford with the old steam service with three car trains of 200 tons. The electric motor cars weigh 25 tons and carry 3,000 people daily with a much more frequent service. It is this frequency of service which secures passengers. Is it not a fact that people object to wait, and will take a slow omnibus which passes their street end rather than go by train which may involve some initial waiting even if the destination be sooner reached? Active people especially are those who will add to the receipts of lines when a frequent service is introduced.

A Golden Fleece.—The story goes that some courtiers, who used every artifice to keep within the Royal favour, wished to make his Majesty believe himself to be an expert angler. But there was no bite, and the King got angry. Thereupon the courtiers secured possession of the first fish they could lay hands upon, and gave secret instructions to a diver to fasten it to the end of the line. The game would perhaps have answered had not a smoked fish been fastened there in error. Royalty knew the difference, with the result that someone suffered. Without pointing a moral to adorn this tall tale, we may remark that a recent event recorded in America is just about as good. A certain Baptist minister, blessed with the name of Rev. P. F. Jernegan, like all good Baptists, had a great belief in water. He found no difficulty in obtaining both gold and silver from the bottom of the sea, and the Electrolytic Marine Salts Company came into existence for the purpose of working out his secret process. Gold and silver was obtained, it is true, but we have seen it stated somewhere that there were confederates, and a diver was in the parson's employ. Someone discovered a neatly laid deception scheme, after the style of the smoked herring story, and now it is stated that the Electrolytic Marine Salts Company has stopped the issue of stock, pending further investigation, as the inventor of the process being, as we remarked, a good Baptist, has again testified to the efficacy of water treatment by himself setting sail for Europe by the first ship without giving notice to his associates. It seems that the company has collected about a million dollars from the public and paid to Mr. Jernegan $338,378. Those connected with the Boston office are stated to be men of honourable reputations, who will spare no effort to ascertain if there has been any deception. Our New York namesake suggests the following refrain for a chorus to be sung by the stockholders of the now celebrated Electrolytic Marine Salts Company:—"Done again! Jernegan gone again! Will he pay back again? Ne'er again!" The whole of which story we take *Cum grano salis!*

THE STARTING OF GAS ENGINES.

L'Industrie Electrique remarks that the production of electric current at *cafés* and other public places by independent means and gas power is attended with economy as compared in general with the purchase of current from outside, but adds that a universal inconvenience of gas engines is the putting of them in motion, which, while often difficult in small sizes for the attendant to accomplish, is quite beyond the power of a single man in sizes of 25 or 50 H.P., a common power to-day. In certain installations, where the motors drive a common shaft by belting, which, in turn drives the dynamos, a small gas engine is provided to set the shaft in motion, and to start one of the larger engines, which in turn is able to set the remainder in motion as required.

On the other hand, numerous installations are provided with accumulators, which serve not only as a reservoir of energy during the stoppage of the engines, but also as regulators of the current, preventing the alternate brightness and comparative dullness of lamps consonant with the periods.

So arranged, it is the custom to borrow the power necessary to put the engines in motion by utilising the peculiar property of shunt-wound dynamos to act as motors under the action of a current the reverse of that they themselves generate, the rotation being in the same direction.

In fig. 1, D represents a dynamo driven by a gas engine. I_n is the shunt winding, and E is the field rheostat.

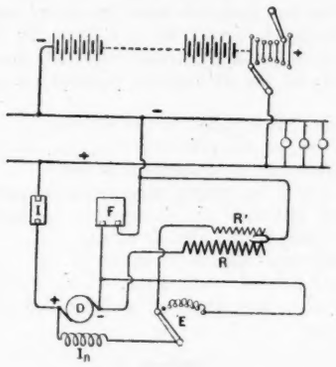


Fig. 1.

The dynamo being coupled to the distribution bars by one or two switches, I, F, of which F in general is automatic, the bars being themselves coupled to the accumulator, it is clear that if we so place the switches we shall send a current inversely to the normal through the armature, and through the field, if the rheostat of the exciter is not open, a current of the same sense as the ordinary excitation. The resulting couple causes the dynamo to revolve in the normal direction. If we do this the dynamo, having to turn the motor against considerable resistance, will acquire in time a speed corresponding with the difference of potential of the current applied to it, and the current will attain an intensity sufficient to burn the armature, unless the belt slips, when the dynamo may even be injured by centrifugal force. It is thus necessary to moderate the current at the outset by introducing such a resistance as may be progressively reduced, and so command the current as to avoid over-heating on the one hand and over-running on the other. In the figure the rheostat, R, should be arranged with one part always in circuit during starting, so that in neither case shall a dangerous intensity be attained, and the other half divided into a large number of sections to be successively cut out. A second rheostat, R^1, the moving contact of which is the same as that of the principal rheostat, is to be coupled to an insulated contact at the head of the field regulator on which rests the handle of this latter during starting. This rheostat will be divided into as many sections as possible, but will be placed entirely outside the circuit before the moving contact of the principal rheostat attains its full position, so that the excitation, and consequently the magnetic field, shall be brought to maximum value at the moment of starting. The large number of sections of the rheostat is necessary to prevent sparking, which will be the more strong as self-induction is considerable.

To put the motor in motion under these conditions, the switch of the field regulator is placed on the insulated contact, and the switch, I, is closed, leaving open the switch, F. The movable double contact of the rheostat, R R^1, is moved to excite the field progressively, and send current into the armature, creating a couple sufficient to overcome the resistance of the engine. Obviously the compression should be suppressed in order to reduce the effort. When starting has once been effected the acceleration is rapid, and the current borrowed from the accumulator diminishes; compression is re-established, gas is introduced, the runner of the rheostat may be put back, nevertheless the current should be allowed to nearly equalise itself in order to diminish sparking.

The rheostat, R^1, might be omitted by placing at once the handle of the field regulator to the extreme right, but in this case the excitation of the dynamo would be diminished by the presence of the rheostat, R, in the circuit. Moreover, the omission might be dangerous to the armature. Figures of the power necessary for starting will be of interest. The author cites a few:—At the Government printing office, five Charon motors of 45 H.P. each drive Fives-Lille dynamos of 250 amperes at 40 volts. To make a sure start requires a current of 90 to 110 amperes, and at most 110 volts, or a rate of, say, 10,000 to 12,000 watts, compression being suppressed. Speed sufficient to allow gas to be introduced is obtained in 25 to 30 seconds.

At the Polytechnic School two 25-H.P. motors are coupled to a very heavy shaft, 15 metres long, and carrying the belts of the two motors and of the two dynamos, and very heavy pulleys. Starting is freely effected with 70 amperes of current, 110 volts by the shaft alone, the motors being disconnected. Speed at once increases, and the current needs to be reduced to 15 or 20 amperes after a dozen or 20 seconds, to prevent over-running. Once the shaft is running, the coupling of one of the motors calls for 50 amperes. In another case a 50-H.P. motor, driving a dynamo of 110 volts by 250 amperes, takes scarcely 85 or 90 amperes to start, and a second motor of half the power, with countershaft, demands about 50 amperes—time, 20 seconds. It appears from the figures that the necessary starting effort of an engine and dynamo is not far from two-fifths that of the maximum power produced, and that the time required is very short, and the consumption of current insignificant.

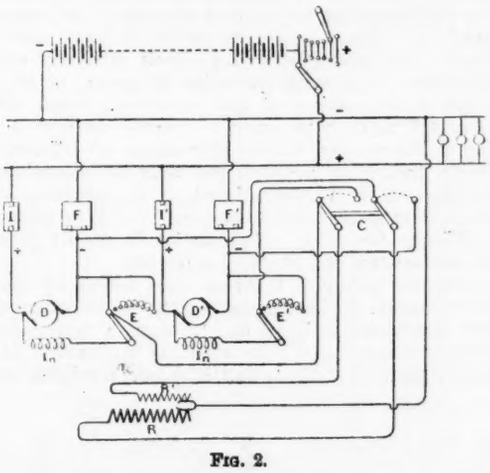


Fig. 2.

Liquid rheostats might find a field in this connection, but would require to be so arranged as never to allow short circuit of the armature, and the value of the resistance must never be below a certain figure.

It is interesting to note that a single rheostat may be made to serve for starting any number of motors and dynamos, a simple commutator device allowing any machine successively to be coupled in the starting circuit. The arrangement with two dynamos is shown in fig. 2, the two-pole commutator, C, being coupled by one axis to the final of the armature rheostat, R, and the other to the rheostat,

R^1. The two left poles of the commutator are connected to the contacts, E E^1, and the two right poles to the negative brushes of the dynamos. A dead pole separates the two poles of each commutator, which serves as a rest point when out of use, and movement is made to the right or left according as one or other dynamo needs starting. Once up to speed the rheostat, R R^1, is brought to the dead point; C is then placed at rest before exciting the machine, and closing the automatic switch, F. The same arrangement is made for four or five machines, or more. The arrangement may equally well be employed to start any motor from any running machine, as well as from an accumulator.

LODGE'S SYSTEM OF SYNTONISED WIRELESS TELEGRAPHY.

THAT the Marconi system of wireless telegraphy has achieved considerable practical success is well known to readers of the ELECTRICAL REVIEW. Messages have been sent over a distance of 16 miles, and printed in dot and dash on the Morse ribbon. The number of words per minute transmitted has not been very great when compared with the speed of the ordinary line wire, but there are many exceptional circumstances in which that drawback may be more than counterbalanced by the several advantages of the Marconi system.

One thing, however, the Marconi system has yet failed to do, that is, to transmit messages which will only be recorded by a single selected receiver. In the early days of the Marconi system there was much talk about this being done, by taking advantage of the principle of resonance; but it has been found that in practice this principle cannot be utilised by the Marconi apparatus. The theoretical conditions under which synchronism or syntony can be made effective in telegraphy by electric waves have been thoroughly investigated by Dr. Lodge, and the results of his investigations have been embodied in practical form in a system of apparatus which has already been explained in general terms in the ELECTRICAL REVIEW, but which we are now able to describe in greater detail.

In Lodge's invention the method of intercommunication consists in utilising certain processes and apparatus for the purpose of producing and detecting a sufficiently prolonged series of rapid electric oscillations, and in so arranging them, that the excitation of a particular frequency of oscillation at the sending station may cause a telegraphic instrument to respond at a distant station, by reason of being associated through a relay with a subsidiary circuit capable of electric oscillations of that same particular frequency, or of some multiple or sub-multiple of that frequency. Other distant stations will similarly be caused to receive messages by exciting at the sending station alternations of different frequency. Individual messages can thus be transmitted to individual stations without disturbing the receiving appliances at other stations which are tuned, timed, or syntonised to a different frequency. Each station is usually provided with both sending and receiving apparatus.

A complete system of Hertzian wave telegraphy may be said to consist, in its simplest form, of an arrangement shown diagrammatically in fig. 1, where A represents the emitting apparatus, and B the receiving apparatus. In the emitter illustrated in fig. 1, electricity from a suitable source,

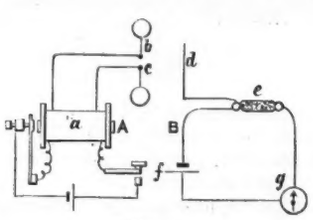


FIG. 1.

such as a Ruhmkorff coil, *a*, is supplied to a pair of conductors, which discharge into each other from knobs *b* and *c*, and thus excite oscillations, which emit one or two waves before they are damped out.

The receiving circuit consists essentially of a collector, *d*, a coherer, *e*, a battery, *f*, or other suitable source of current, and a telegraphic receiving instrument, *g*, all in electrical connection as shown.

In Lodge's system is a definite radiator consisting of a conductor or pair of conductors (represented by the letters h h^1 in fig. 2 and following figs.). These conductors are of large capacity, and may be arranged either as a Leyden jar, or preferably spread out separately in space (one of them being the earth when desired). To h and h^1 respectively are joined a pair of polished knobs, h^2 h^3 (protected by glass from ultra-violet light), which form the adjustable spark

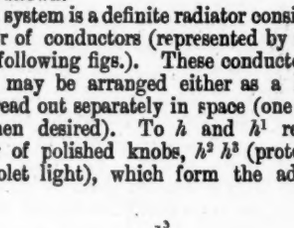


FIG. 2.

gap called the "discharge gap." Between either capacity area and its knob is placed a self-inductance coil, *i.e.*, a coil of wire or metallic ribbon, h^4, preferably insulated with any solid or fluid insulator, as in fig. 2, or in air, and of a shape suitable to attain the greatest inductance with a given amount of resistance. The object of this coil is to prolong the electric oscillations occurring in the radiator, and so constitute a radiator of definite frequency or pitch, emitting a succession of true waves. This renders syntony in a receiver possible, because the exactitude of the response depends on the fact that the total number of oscillations in a suitably-arranged circuit is very great, so that a very feeble impulse is gradually strengthened till it causes a perceptible effect, on the well-known principle of sympathetic resonance.

The electricity is supplied to the radiator by a Ruhmkorff coil, a Tesla coil, or an influence machine, in one of three different ways according to circumstances.

The first way is by leading wires from the machine to the two discharge knobs, h^2 h^3, which gives a discharge which follows on a fairly steady electric strain.

The second way consists as shown in fig. 3, in having a supplementary pair of spark gaps, h^6 h^7 (which are called "supply gaps"), one knob of each (called the receiving

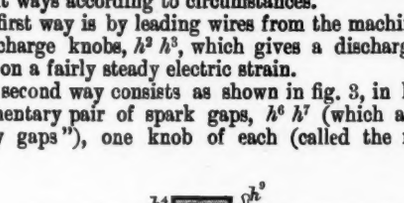


FIG. 3.

knob), being attached to the middle or other convenient point of each capacity area, h h^1, and the other knob of each pair (called the supply knob) being connected by wires, h^8, to the Ruhmkorff coil, *a*, and brought moderately near the first, so that when the coil is in action the capacity areas shall receive their positive and negative charges by aerial disruption, that is, in a sudden manner, rather than by the slower process of metallic conduction. They are then left to discharge into each other through the connecting coil, h^4, and across the short spark gap between the knobs, h^2 h^3. The best width of this gap depends on circumstances, and it may be closed altogether without stopping the action. The gap between the knobs, h^2 h^3, may, if desired, be closed by a shunt, h^9.

On the third plan, as indicated in fig. 4, a Leyden jar or other suitable condenser, *j*, is intercalated in each of the wires, h^8, leading from the coil, *a*, to the supply knobs, so that the knobs are supplied from the outer, that is, the uninsulated coat of each jar, while between the inner coats or coil terminals, a third spark gap, called the starting gap, also consisting of two knobs, h^{10} h^{11}, is arranged. The outer coats of the jars must not be insulated from each other; they are usually joined by a self-inductance coil of fairly thin wire, *k*, so as to permit thorough charging. When the discharge occurs, this wire acts as an alternative path, but on

account of its self-inductance does not prevent the sparks at the supply gaps.

By both the methods described with reference to figs. 3 and 4, the two capacity areas, h, h^1, which, together with the inductance coil between them constitute the radiator by aerial disruption or impulsive rush, are charged. The advantage obtained is that charges so communicated are left to oscillate free from any disturbance due to maintained connection with the source of electricity, and therefore oscillate longer and more simply than when supplied by wires in the usual way. Moreover, the capacity areas of the radiator are thus more conveniently employed as the capacity areas of a receiver without need of disconnection.

The arrangement described with reference to fig. 4, illustrates most completely the method of charging the capacity areas, h, h^1, with an impulsive rush.

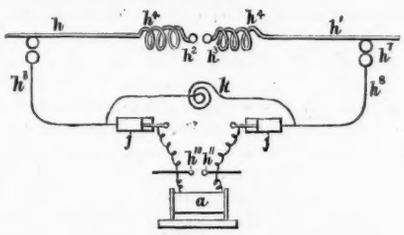


Fig. 4.

The action is as follows:—The Ruhmkorff coil a charges the jars j, whose outer coats are connected, and discharges them at the starting gap, h^{10}. This spark precipitates a discharge at the supply gaps, h^7 h^8, and suddenly supplies the capacity areas, h h^1, with electric charges, which then surge through the connecting coil, h^4 (divided into two parts in this figure), and spark into each other at the discharge gap between the knobs, h^2, h^3. This last discharge is the chief agent in starting oscillations which are the cause of the emitted waves. But it is permissible in the arrangements, figs. 3 and 4, to close this last gap when desired, and so leave the oscillations to be started by the sparks at the supply gaps alone, their knobs, in that case, being polished and protected from ultra violet light, so as to supply the electric charge, in as sudden a manner as possible.

Spheres or square plates, or any other metal surfaces may be employed as capacity areas, but for the purpose of combining low resistance with great electrostatic capacity, Lodge prefers cones or triangles, or other diverging surfaces, with vertices adjoining, and their larger areas spreading out into space. A single insulated surface may be used in conjunction with the earth, the earth or conductors embedded therein constituting the other oppositely charged surface. Radiation from an oscillator consisting of a pair of capacity areas is greater in the equatorial than in the axial direction, and, accordingly, when sending in all directions is desired,

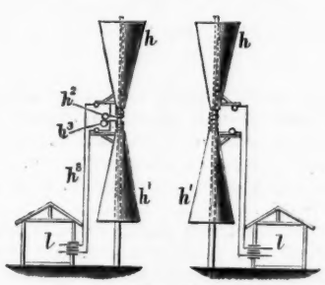


Fig. 5.

it is well to arrange the axis of the emitter vertical. Moreover, radiation polarised in a horizontal plane, that is, with its electric oscillations vertical, is less likely to be absorbed during its passage over partially conducting earth or water. A pair of insulated capacity areas arranged for long distance signalling is shown on the left-hand side of fig. 5.

Fig. 6 shows a single insulated capacity area, h, with the earth acting as the other surface, and leading up to the spark knobs, h^2, h^3, by a triangular sheet or cone, h^1, so as to afford good conductance even to rapidly alternating currents. The wire, h^8, in this case leads to one terminal of the Ruhmkorff coil, a, the other terminal of which is taken to earth. The capacity area, h, is insulated as shown at h^{12}.

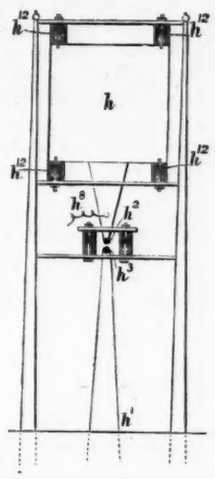


Fig. 6

Fig. 7 shows an arrangement which will catch the wind less, and which is fitted with a syntonised coil, h^4.

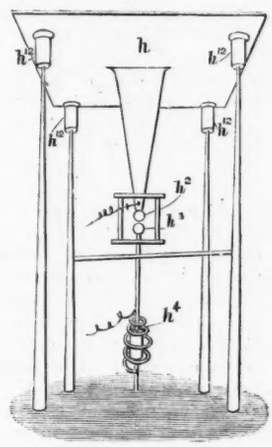


Fig. 7.

Fig. 8 shows an insulated metal surface, in the form of a roof, h, of a shed or building, which may be used as a

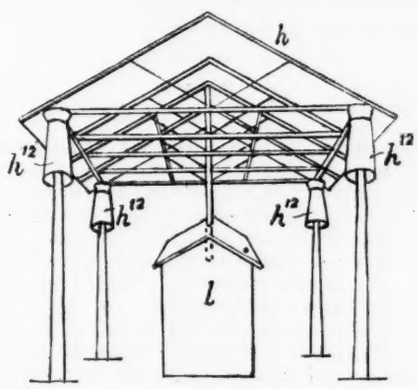


Fig. 8.

capacity area, suitable connection and apparatus (not shown) for emitting or receiving being placed inside the little house, l.

The self-inductance coil, represented at h^4 in all the figures, is a coil of highly conducting wire or ribbon, well insulated by air or by some other medium, as already described, or else covered to a sufficient thickness with insulating material. It may be either a flat coil, enclosing a plane area and shaped so as to have a maximum self inductance for a given resistance, or it may be a cylindrical coil wound on a finely sub-divided iron core, as shown at m, fig. 9, either ring-shaped, or U-shaped, or straight.

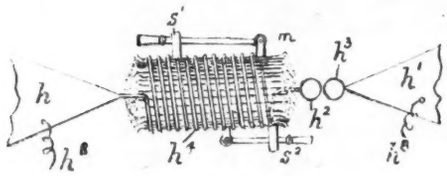


Fig. 9.

The discharge knobs, h^2, h^3, may be arranged at one end of such a coil as shown in figs. 2, 3, 7, and 9, or the coil may be in two halves, with knobs inserted in the middle at pleasure.

Several such coils, h^4, h^{4x}, h^{4xx}, with their knobs, h^2, h^{2x}, h^{2xx}, may, as shown in fig. 10, be arranged for use with a single pair of capacity areas, and any one of them may be

Fig. 10.

brought into action by a suitable switch. Thus the desired frequency of vibration or syntony with a particular distant station may be attained by replacing one coil by another, for the frequency can be adjusted either by varying the capacity of the condenser or jar or other conductor employed, or the charged body, or, on the other hand, by varying the number and position of coils or other portion of the discharge circuit. That discharger is in action whose spark gap is allowed to operate, and a switch, A^1 B^1 C^1, can determine which of a set of different coils shall be utilised. Fig. 11 illustrates the form of switch indicated at fig. 10.

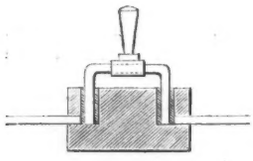


Fig. 11.

An alternative plan to that described in fig. 10 is to connect the capacity areas through one pair of knobs and a single large coil of a considerable number of turns, as shown in fig. 9, and to have keys or plugs or switches, s^1 and s^2, whereby some of the turns can be shunted out of action, so that the whole or any smaller portion of the inductance available may be used, in accordance with the correspondingly tuned receiver at the particular station to which it is desired to signal. This arrangement may be used in lieu of, or in combination with, interchangeable inductance coils such as are shown in fig. 10; in the latter case they are useful for correcting slight errors in tuning for any one station.

Another plan, and one well adapted to secure accurate tuning, is to arrange some or the whole of a syntonising coil so that its parts may be made to approach or recede from one another. The one is named by Lodge an adjustable coil, and the others replaceable or interchangeable coils.

A receiver, or resonator, consists of a similar pair of capacity areas connected by a similarly shaped conductor or self-inductance coil, the whole constituting an absorber arranged so as to have precisely the same natural frequency of electrical vibration as the radiator in use at the corresponding emitting station; but it must not have a spark gap such as h^2 h^3, or if it have a spark gap the same must be carefully closed, or shunted, or bridged across by a good short conductor, for example like fig. 11, before the arrangement can be properly used as a receiver.

Referring to fig. 3, it will be seen that that diagram illustrates a combined emitting and receiving apparatus. When in use as a radiator, the gap between the discharge knobs, h^2 h^3, is left open. When utilised as a resonator, the said gap is closed by the shunt, h^9 (shown on a larger scale, fig. 11), and the coherer, e, battery, f, telegraphic receiving instrument, g, are connected through a thin wire, x, from each end of the inductance coil, h (*i.e.*, from each of the capacity areas).

If the Ruhmkorff coil, a, had been actually connected to the capacity areas, h h^1, as in fig. 2, then it must be detached and substituted by the coherer circuit when a receiver is required; but if the charge has been supplied through gaps as in figs. 3 and 4 (and this is the best plan), then the Ruhmkorff connections can be left unaltered, as it in no way then affects the action of the resonator, provided always that the coil is not put in action while the receiving circuit is connected up.

A coherer consists of any arrangement which drops in resistance on receipt of an electric impulse, and rises to its old resistance on being subjected to a mechanical impulse, such as a tremor or tap.

A coherer circuit is any known arrangement for observing or recording effects due to fluctuations in the electrical resistance of a coherer.

Lodge makes use of Branly's coherer, in which a pair of conductors are embedded in metallic grains or powder or filings. He prefers to use selected iron filings of uniform size, sealed up in a good vacuum, and with communicating surfaces or electrodes reduced to points of thin platinum wires fused into the glass with their ends close together. Instead of the Branly or other well-known coherer, Dr. Lodge also makes use of the coherer illustrated, fig. 12, wherein a point, n, rests lightly on a flat metallic surface, o.

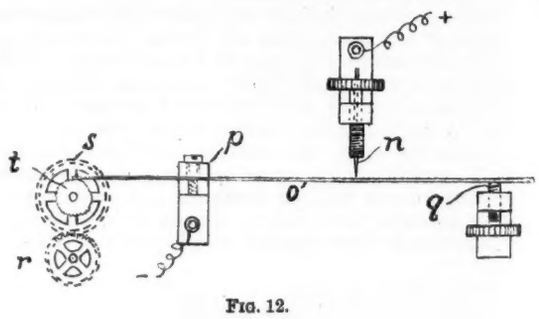


Fig. 12.

For instance, a needle point of steel or platinum may make light contact with steel or aluminium or other spring like a watch spring, straight or bent, fixed at one end, p, and delicately adjustable by a thumb-screw, q, at some other part, so as to regulate the pressure which it exerts on the fixed needle point.

Whenever an electric wave or impulse from a distant radiator arrives and stimulates electric vibrations in the syntonised resonator or absorber arranged for the purpose, the delicately-adjusted junction of the two metals, or of the metallic or other particles which are connected up to the resonator so as to feel these vibrations, suddenly and greatly changes its electrical resistance, and this diminution of resistance enables a local battery to actuate a relay, or a telephone, or other telegraphic instrument in circuit therewith.

To break contact again, or to restore the original greater resistance, any form of mechanical vibration suffices. Lodge mounts on the stand of the coherer either a clock or a tuning fork, or a cog-wheel, or other device for causing a shake or tremor of sufficient intensity, maintaining it in

motion by either a spring or weight, or by electrical means. In fig. 12, *r* and *s* are two wheels of a clockwork train. Upon the arbor (or on a disc mounted thereon) is a series of serrations or the like, *t* (shown exaggerated in the drawing), which as the wheel rotates effects the vibration of the lever or spring, *o*. Such a tapper as is used in dentistry likewise serves very well. Or the mere motion of any clockwork attached to the stand will suffice. An exceedingly slight, almost imperceptible tremor is all that is usually needed.

The diminution of resistance takes place instantaneously, and contact is broken again in a very small fraction of a second later. The instant it is broken the junction is ready to receive a fresh signal. The rapidity of signalling depends on the quickness of response of the signalling instrument, and it depends also on the rapidity with which the mechanical arrangement can break or interrupt the cohesion directly after the electrical stimulus has established it. Lodge has found that when a telephone is used the coherer restores itself without specially arranged tremor, and that a telephone is the quickest responder that can be used.

In the coherer circuit the coherer is usually arranged with the coherer in simple series with a battery (voltaic or thermal) and a galvanometer or other indicator or recorder of fluctuations of current. The terminals of this series of instruments are then connected to the capacity areas of the receiver close to its self-inductance coil, so that this same coil of wire completes and forms an essential part of the coherer circuit. The coherer is thus affected by every electrical disturbance occurring in the connecting coil or in its capacity areas, and by the aid of the battery at once enables the telegraphic or telephonic instrument to appreciate and indicate the signals. This plan is shown in fig 13. It is an improvement on any mode of connection that has previously been possible without the connecting coil.

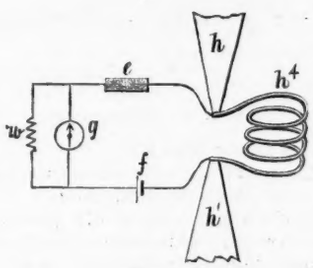


Fig. 13.

In some cases Lodge, as shown in fig. 14, surrounds the syntonising coil of the resonator with another or secondary coil, *u* (constituting a species of transformer), and makes this latter coil part of the coherer circuit, so that it shall be secondarily affected by the alternating currents excited in the

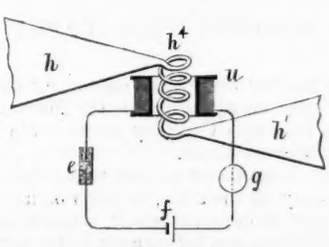


Fig. 14.

conductor of the resonator. The coherer is thus stimulated by the currents in the secondary coil, and not primarily by the currents in the syntonising coil itself, the object being to leave the resonator freer to vibrate electrically without disturbance from attached wires.

In all cases it is permissible, and sometimes desirable, to shunt the coils of the telegraphic instrument by means of a fine wire or other non-inductive resistance, as shown at *w* in fig. 13, in order to connect the coherer more effectively and closely to the capacity areas or receiving arrangement whereby it is stimulated.

Dr. Lodge has not yet published the results of any experiments in which distances have been traversed by means of his signalling apparatus as great as those that have been attained by the Marconi system. A few months ago he informed us that he had transmitted signals over a distance of one mile, without any perceptible falling off in the efficiency of the apparatus. This points to much better results being achieved. The utilisation of resonance would appear to indicate that the inconvenience of the long vertical conductor in the Marconi apparatus may be altogether got rid of. The results of further experiments with Lodge's apparatus will be eagerly looked for by those interested in this subject.

ON THE SMASHING POINT OF A GLOW LAMP.

By F. W. CARTER, B.A.

The fact that the candle-power of a glow lamp diminishes as it approaches the end of its life, makes it, in the case of many brands of lamp, cheaper to throw away the lamp at a certain period of its existence than to let it burn out. It is the object of the present article to show when, in the life of a lamp, the user will have had the best value for his money, or, in technical parlance, to find the smashing point of the lamp.

The smashing point of a lamp depends not only on its life characteristics, but also on its cost, and on the cost of electrical energy—the greater the first cost of the lamp and the lower the cost of energy, the longer may it be advantageously kept in use. Prof. Ayrton,* has advocated using glow lamps, where energy is dear, only for a portion of their life, and then selling them where energy is cheap, in order to advantageously burn them out.

Other considerations than mere economy may, however, make it advantageous to remove lamps from use before their light has largely diminished. Where a uniformly good light is required, it may be desirable to take the lamps out of use comparatively early. Then they may be transferred to such offices as require less light, or to rooms where the fittings have been installed closer together for the purpose. If the cost of transfer be added to the initial cost of the lamp, the following determination of the smashing point will apply.

Let the full-line curve in fig 1. represent the average relation between candle-power, in a definite direction, and time,

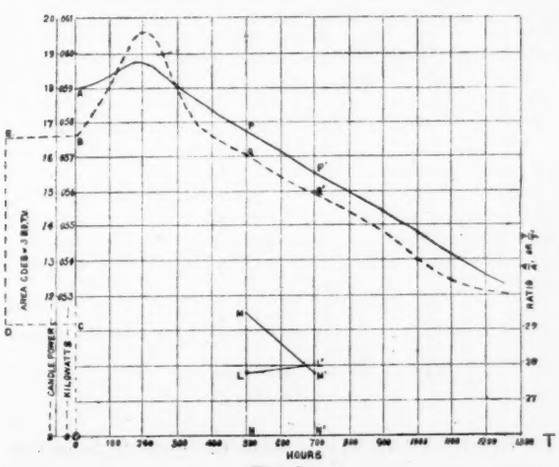


Fig. 1.

for lamps of a particular type, run at normal voltage; and the dotted curve, the relation between the power taken and the time. Then, in any time, represented by O N, measured from the beginning of the lamp's life, the amount of light

* See *Electrician*, September 29th, 1893.

obtained from the lamp, in candle-power hours, is represented by the area O A P N, and the amount of energy used by the lamp in that time is represented by the area O B Q N. If to the latter area be added an area C D E B, representing the total cost of the lamp—the unit of cost being the price of a unit of energy—the increased area so obtained, *i.e.*, O C D E B Q N, will represent the total expenditure on the lamp to time N.

The smashing point will be reached when the ratio of the total amount of light obtained to the expenditure on the lamp is as great as possible, that is, when the ratio of the area O A P N, to the area O C D E B Q N, is as great as possible. Calling these areas A and A^1 respectively, we have to determine the time when $\frac{A}{A^1}$ is a maximum.

When this is the case—

$$\frac{d}{dt}\left(\frac{A}{A^1}\right) = 0,$$

or
$$A^1 \frac{dA}{dt} - A \frac{dA^1}{dt} = 0,$$

but
$$\frac{dA}{dt} = P N = y, \text{ let us say,}$$

and
$$\frac{dA^1}{dt} = Q N = y^1, \text{ say,}$$

$$\therefore A^1 y - A y^1 = 0,$$

or
$$\frac{A}{A^1} = \frac{y}{y^1}.$$

We thus have to determine the time when the ratio of A to A^1 is the same as the ratio of y to y^1. We can do this with sufficient accuracy as follows: Find the ratio of A to A^1, and y to y^1 for a time represented by N, and also for a time represented by N^1. Along N P set off N L equal to $\frac{A}{A^1}$, and N M equal to $\frac{y}{y^1}$ for the time N, with similar points L^1, M^1, along N^1 P^1, join L L^1 and M M^1 intersecting in X, then clearly at the time represented by the abscissa of X, $\frac{A}{A^1} = \frac{y}{y^1}$ approximately, and this instant of time is the smashing point. Thus, in the case of the lamp to which the curves in the figure apply, if the cost of the lamp be 1s. 6d., and the cost of energy 6d. per unit, the value of $\frac{A}{A^1}$ at 500 hours is 278, and of $\frac{y}{y^1}$ 295, whilst the value of $\frac{A}{A^1}$ at 700 hours is 280, and of $\frac{y}{y^1}$ 278. Thus the smashing point, determined by

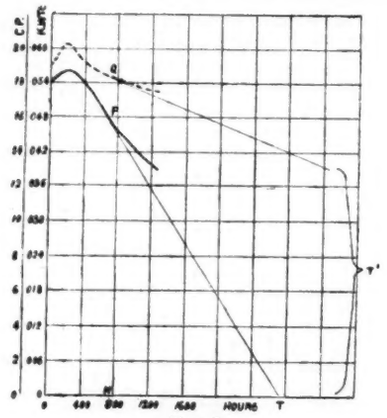


FIG. 2.

the construction given, is at about 670 hours from the commencement of the life of the lamp.

It may be noticed that initially $\frac{A}{A^1}$ is zero and increasing, so that the first stationary point which it passes through is a maximum.

It is conceivable, though hardly likely, that it may afterwards pass through a minimum and then another maximum, but the question of whether the instant obtained as the smashing point really corresponds to a maximum value of $\frac{A}{A^1}$ is immediately settled by observing whether the tangent to the candle-power curve, at the point corresponding to the time obtained, cuts the axis of abscissæ sooner or later than the tangent to the power-curve at the point corresponding to the same instant of time. Thus in fig. 2, if P and Q be points on the two curves corresponding to 670 hours, and P T, Q T^1 be tangents to the curves at these points, cutting the time line in T and T^1, $\frac{A}{A^1}$ is a maximum at this time if O T is less than O T^1. This can be seen as follows:—

$$\frac{d^2}{dt^2}\left(\frac{A}{A^1}\right) = \frac{1}{(A^1)^2}\left(A^1 \frac{d^2 A}{dt^2} - A \frac{d^2 A^1}{dt^2}\right),$$

when
$$\frac{d}{dt}\left(\frac{A}{A^1}\right) = 0.$$

If $\frac{A}{A^1}$ is a maximum, $\frac{d^2}{dt^2}\left(\frac{A}{A^1}\right)$ is negative, thus

$$A^1 \frac{d^2 A}{dt^2} - A \frac{d^2 A^1}{dt^2} \text{ is negative;}$$

or since
$$\frac{A}{A^1} = \frac{y}{y^1} \text{ and } \frac{dA}{dt} = y, \frac{dA^1}{dt} = y^1,$$

$$y^1 \frac{dy}{dt} - y \frac{dy^1}{dt} \text{ is negative.}$$

Now
$$\frac{dy}{dt} = \frac{NP}{TN} = -\frac{y}{NT},$$

and
$$\frac{dy^1}{dt} = \frac{NQ}{T^1 N} = -\frac{y^1}{NT^1}.$$

Thus $\frac{A}{A^1}$ is a maximum if

$$-y^1 \frac{y}{NT} + y \frac{y^1}{NT^1} \text{ is negative,}$$

or if
$$\frac{y y^1}{NT \times NT^1}(NT - NT^1) \text{ is negative,}$$

or if
$$NT - NT^1 \text{ is negative;}$$

that is, if N T^1 is greater than N T.

Thus, in the case of the lamp whose curves are given, we see that the ratio of the total candle-hours obtained to the total expenditure is a maximum at 670 hours, and does not, as far as the curves go, pass through a minimum.

The particulars required to construct the curves should be known to the makers of the lamps, and a table giving the smashing points for different values of the ratio of the cost of the lamp to that of a unit of energy would, if reliable, be of considerable value to large consumers.

The curves given in the figures represent an actual case, and so show the sort of thing one might expect.

MARCONI TELEGRAPHY.

DURING the past few weeks some interesting and important experiments have been made with the Marconi system by the Wireless Telegraph Company between the Royal Yacht *Osborne* and Osborne House.

Perfect signals are stated to have passed both ways during the whole 10 days of the trials, no hitch occurring from first to last. Numerous messages passed between the Queen and the Prince of Wales, and between the Prince and a number of other members of the Royal family, and one or two Cabinet Ministers. Mr. Marconi had charge of the trials. Every morning a bulletin was sent to the Queen of the condition of the Prince by wireless telegraph. Messages also passed freely between the Duke and Duchess of York, and the Duke, who displayed great interest in the system while on board the yacht, paid several visits to the instrument room.

The height of the mast on shore was 105 feet, and that of the top of the wire from the deck of the *Osborne* was 83 feet. The yacht was moored in Cowes Bay, at a distance of nearly two miles from Osborne House, the two positions not being in sight of one another, as they were intercepted by a hill to the rear of East Cowes, which would have rendered

signalling impossible between these two stations by means of any optical system. The messages varied in length, some having as many as 100 to 150 words, which is tantamount to a decent letter. Mr. Marconi's assistants were on duty from 9 a.m. until 7.30 p.m. without intermission during the whole period. Towards the end of the time, on the 10th inst., the yacht went on a cruise towards Sandown, and the messages were received correctly close off the *Nab* lightship, which is moored off Bembridge. On the way there, when under steam, a lengthy message was received by the Prince from the Duke of Connaught, and the reply was successfully despatched, though well out of sight of Cowes and Osborne. On the 12th inst. the yacht cruised as far as the Needles, or rather outside, and went on until the instruments picked up Alum Bay station —the Needles Hotel—continuing in communication with them all the way, perfect messages being passed to and from. Communication was kept up throughout the cruise with either the Osborne station or the Wireless Telegraph Company's station at Alum Bay. During the whole of the cruise the Osborne pole was obscured, and all the messages had to pass overland, and the Alum Bay pole was also obscured until coming right into the Bay, on account of the station being situated very much below Heatherwood. The messages were sent to Alum Bay from a distance of nearly 7½ miles, although the ground lying between was exceedingly high; in fact, it was about the highest land met with during the time. It was so high, that the poles were screened by hundreds of feet.

The Prince of Wales and other Royalties gave expression to Mr. Marconi of their high appreciation of his system, and their astonishment at the perfection to which it had been brought. The Prince presented Mr. Marconi with a souvenir in the shape of a handsome scarf pin, and wished him every success with his very interesting invention.

Fig. 1.—Depositing Room.

COWPER-COLES'S ELECTROLYTIC METHOD FOR THE EXTRACTION OF ZINC FROM REFRACTORY ORES.

During the last few years considerable attention has been given to the treatment of complex ores such as those existing at Broken Hill, which, on an average, contain about 25 per cent. of lead, 20 per cent. of zinc, and some 20 ounces of silver per ton. The following is a complete analysis of a sample of Broken Hill ore:—

Lead	30·05	per cent.
Zinc	23·77	„ „
Silver	·06	„ „
Manganese	·93	„ „
Iron	3·91	„ „
Sulphur	18·96	„ „
Alumina	1·20	„ „
Silica	20·05	„ „
Oxygen, traces of gold, arsenic, &c. ...	1·07	„ „
	100·00	„ „

The fine silver amounts to 22 ozs. 10 dwts. per ton of 20 cwts.

Several attempts have been made, on a commercial scale, to deal with such ores, but the difficulties that have arisen in practice have led to the abandonment of such processes. Extracting the zinc with sulphuric acid has been tried by Siemens & Halske and others. To obtain a satisfactory leach with sulphuric acid, it is essential that the ore should be roasted quite sweet, free from sulphur, which necessitates the ore being roasted for a long time at a low temperature. Even when the roasting has been done carefully, the extraction of the zinc has been very imperfect, and the losses of the zinc excessively heavy, as it was found necessary to throw away a large quantity of the solution to get rid of the impurities, such as silica, manganese, and aluminium. The Cowper-Coles process claims to have entirely overcome all these difficulties, and to have other substantial advantages both as regards economical working and the purity of the products obtained.

Experimental works have been erected in Cornwall to try the process on a commercial scale, the capacity of the leaching vats being large enough to deal with 40 to 50 tons of ore per week. Fig. 1 shows the arrangement of the electrolysing cells, also the circulating arrangements, the anodes being of sheet-lead and the cathodes of aluminium. The difficulty

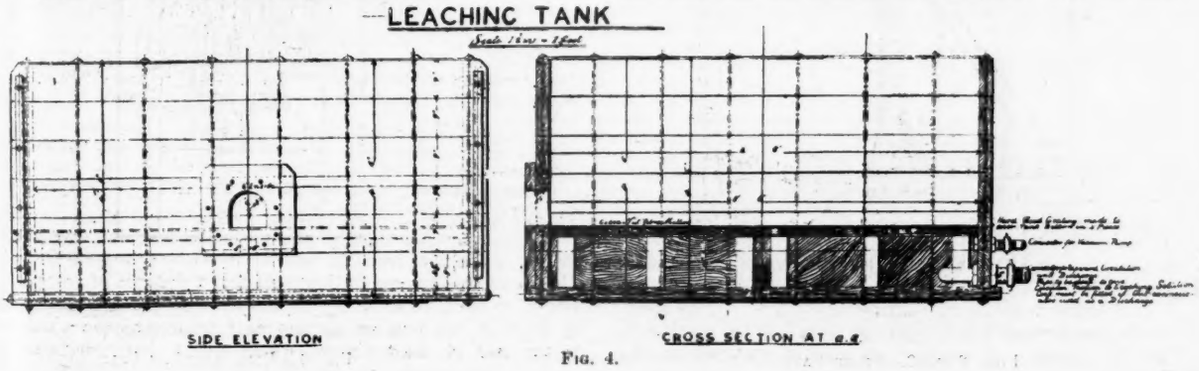


Fig. 4.

of the roasting has been overcome in the Cowper-Coles process by the addition of a mixture of other ores, and the use of an air rake, which facilitates the process of roasting, and enables a sweet roast to be obtained with the expenditure of a small amount of fuel. The object being aimed at is not to drive off the sulphur so much as to oxidise it. The ore, after being crushed dry and roasted, is screened, so as to remove the very fine dust or slimes, which are treated by a special process in separate vats, figs. 2 and 3. The screened ores are placed in vats, as shown in fig. 4, which are provided with false bottoms or filter beds. Fig. 5 gives details of the discharge door, and fig. 6 details of the electrolysing cells. The solution employed for leaching out the zinc is a weak solution of sulphuric acid, which can be made from the sulphur dioxide driven off from the ore during the process of roasting. The leaching solution, after being drawn off from the epuration tanks to remove any copper that may be present, is then circulated through a series of electrolysing cells constructed as shown in fig. 1, where the zinc is deposited in the form of metallic plates on an aluminium cathode, or in the

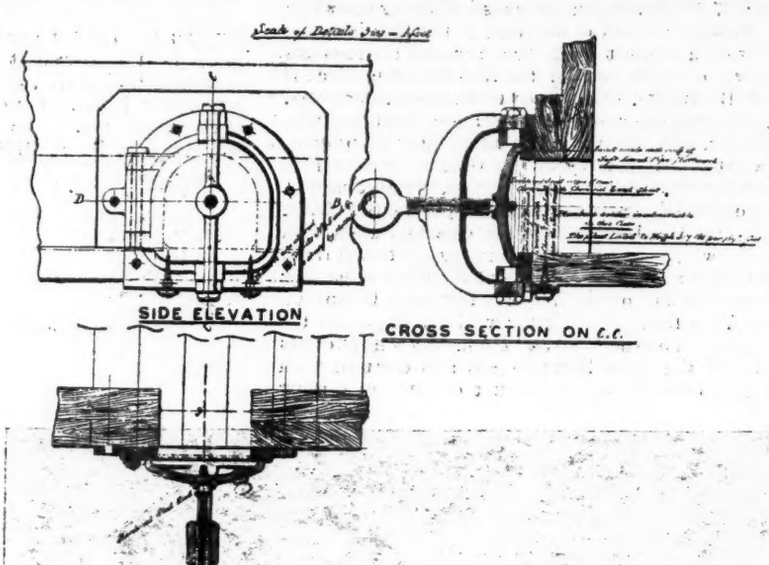
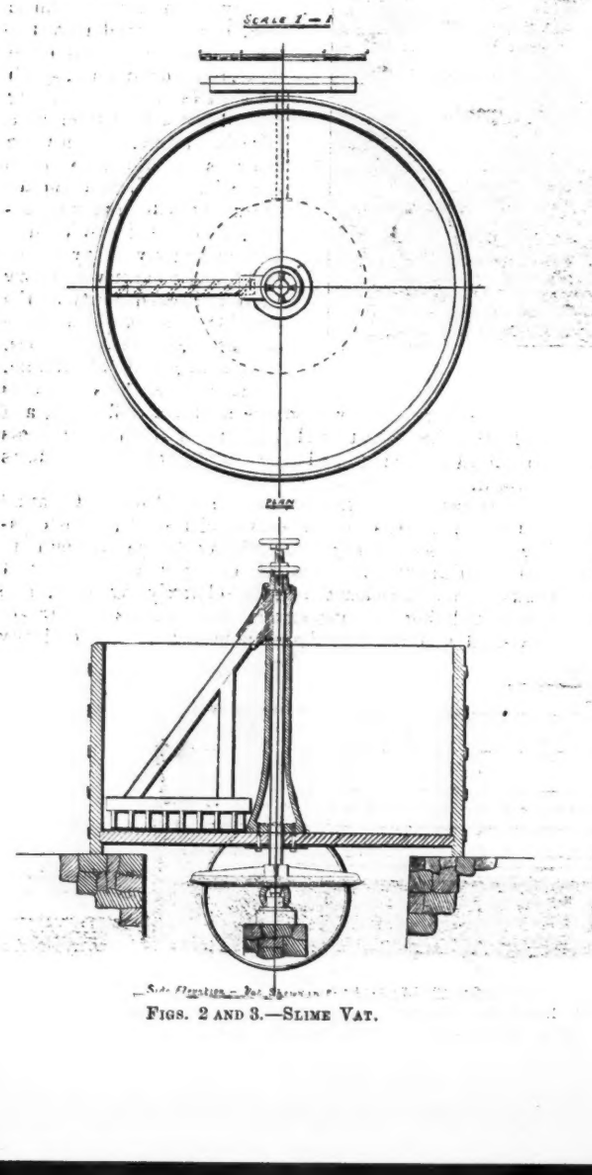


FIG. 5.—DISCHARGE DOOR.



FIGS. 2 AND 3.—SLIME VAT.

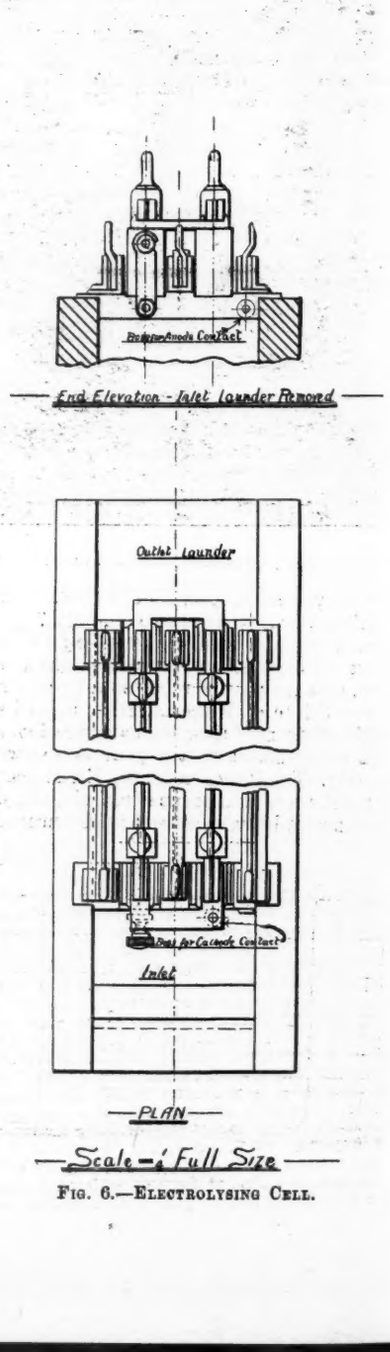


FIG. 6.—ELECTROLYSING CELL.

form of zinc sponge, which, when dried, forms a substitute for zinc dust, which is in considerable demand. The voltage at the terminals of the dynamo is 60, the electrolysing cells being worked in series. It is found that by using a suitable strength of solution only the zinc and copper are removed from the ore, and that the other metals present are not dissolved. The residue, after the zinc has been leached out within a few per cent., is then washed to remove the soluble zinc sulphate. The lead and silver remaining in the residue can be extracted by any of the well-known methods.

At a future date we hope to give a more detailed description of the process; but at the present time, pending the granting of certain foreign patents, we are unable to do so.

CORRESPONDENCE.

Electrical Work in Ireland.

I note a reference to my name in your last week's issue under the heading "Limerick." As this reads rather peculiarly, you will perhaps excuse my placing the true facts before you. The Limerick Corporation have been in communication with me with regard to the question of electric tramways, and it was arranged that I should attend a meeting of the Council. After which, arrangement was made for me to inspect the city, and also the proposed routes of the tramways company, with a view to advising the Corporation on the plans and proposals of that company.

The following may also prove of interest respecting Queenstown and Fermoy:—I attended a special meeting of the Queenstown Commissioners to explain the electric lighting scheme I have prepared, which was approved. The Fermoy Commissioners have finally settled the agreement for the establishment of an electric lighting undertaking by a company, and have approved the scheme I have prepared for carrying out the same.

F. J. Warden-Stevens.

C. Gailud (?).—We described the renewable incandescent lamp in our issue for January 28th, 1898, page 122. Your friend is quite correct; there are plenty of cheap incandescent lamps obtainable.—Eds. Elec. Rev.

BOILER INSPECTION.

A correspondent of the *Practical Engineer* calls attention to two systems of boiler inspection. By one system a boiler is rarely examined twice by the same man until after the lapse of some years. In this system, every inspector is centred in or near the head-quarters of the inspecting company, and makes all his journeys from that centre, and is liable to be sent all over the three kingdoms. In the second system, inspectors are appointed to districts, and in the course of time they examine every boiler in that district many times over. Obviously they soon learn all about every boiler if they work conscientiously. They are able to compare the condition of the boiler year by year, and their work becomes progressively easier and easier. On the first system, a fresh man sees a boiler every year, and the argument in favour of this is, that as different men vary in the attention they pay to different parts of a boiler, there is a better chance of acquiring full information. We confess we think the method of the second system is the better. The inspector gets to know his men as well as his boilers, and this is often a great help. The regular attendant is often able to give valuable aid to the inspector. He will tell the inspector of some new leak he has discovered, and point out that a certain corrosion is becoming worse, and in this way the fullest information is gained of the various boilers. With the change of inspectors, each man can only diagnose his patient from a single interview, and we think that there is a smaller feeling of responsibility upon the inspector. Certainly, after the lapse of a year, he may feel relieved considerably, for his load of responsibility is then taken up by the latest inspector. Of course it may be questioned if it is wise for one man to carry the load of responsibility for all the boilers in a district, but the system of districts renders the inspector's duties far less onerous than when he goes a stranger into every works. The work of inspecting boilers, and putting down the information acquired in such a manner as to be correctly weighed at head-quarters for report to the boiler owner, is done on the whole with remarkable accuracy.

We have seen many series of reports by many men year after year upon the same boilers, and have been surprised to note how very accurately the different reports of different men fit together. Progressive deterioration may be traced through a series of years, until the boiler is finally condemned, and such a series of reports constitutes in itself a concise history of boiler making and boiler practice, for while the series is continuous as regards the numbers of boilers, the boilers themselves may have been changed two or three times, and at some old-established works, have been passed through the various stages of pressure from 20 lbs. to the modern 200 lbs. The accompanying sketches, the details of stays and of rivet seams, safety valves, &c., all combine to show the progress of the boiler makers' art.

Inspection of a modern boiler is a far easier matter than inspecting one of the old boilers of 30 years ago, set with low bottom flues and narrow side flues. The standard 8-feet Lancashire boiler of to-day, free of such useless encumbrances as cross tubes in the furnace flues, can be inspected almost without the inspector becoming dirty if the sweep has done his duty. Probably inspectors are better aware than anyone else how useless the cross tubes in a boiler flue tube really are, and how very much more free of soot are the flues of a boiler which has no such cross tubes. The cross tubes add about £2 each to the cost of a boiler to the owner. They are absolutely useless as an aid to circulation, are most detrimental in the matter of good combustion, are a very serious hindrance both to inspection and to the work of the sweep, and they hinder the draught. At the same time they are not a source of strength to a flue tube, and the time has surely come when such additions ought to be condemned. If inspectors were asked they certainly would be. Even if they add to the strength of the tube they leave the furnace unstiffened so that they are at most like so many §th links in a ½-inch chain.

LEGAL.

The Bristol Tramways and Carriage Company *v.* The National Telephone Company.

Before Mr. Justice North, in the High Court of Justice (Chancery Division) last week, on the application *ex parte* of Mr. Stewart Smith, on behalf of the plaintiffs, Mr. Justice North granted an injunction over Wednesday, 17th inst. (with leave to serve notice of motion for that day before the Vacation Judge) to restrain the defendants (in effect) from laying their wires (without the previous consent of the plaintiffs) under that part of a street, called St. Augustine's Road, at Bristol, which the plaintiffs are liable, by the Tramways Act, 1870, to keep in repair—that is, so much of the street as lies between a distance of 18 inches on either side of the outer line of the plaintiffs' tramway. But his Lordship gave leave to the defendants to move before Mr. Justice Romer the next day to discharge the order, upon their informing the plaintiffs of their intention to do so.

Before Mr. Justice Phillimore, sitting as Vacation Judge, on Wednesday, the matter came on for hearing. Mr. Mulligan, Q.C., appeared on behalf of the plaintiff company, and Mr. Roskill for the defendant company.

Mr. Mulligan said this was an application by the plaintiff company to continue an interim injunction granted by Mr. Justice North on August 11th. The order was, "That defendants be restrained until Wednesday, August 17th, from placing, except with the consent of the plaintiff company, any wires across or beneath so much of the public road known as St. Augustine's Bridge, Bristol, as lies within the rails of the plaintiffs' tramway, and a space of 18 inches on either side thereof." Plaintiffs were a company authorised to lay tramways, and under the Act they were made liable to keep in repair the road between their rails and a space of 18 inches on either side. Defendants were attempting to lay the wires for their telephone service underneath and adjacent to the plaintiffs' rails.

Mr. Justice Phillimore: Do you say they cannot cross the road underneath your rails?

Mr. Mulligan: Not without our consent. Counsel read the sections of the Telegraph Acts and the Tramways Acts upon which he relied to support that contention.

Mr. Roskill, for the defendant company, said they had on several previous occasions carried wires for the telephone service underneath the tram rails, and now, for the first time, plaintiffs sought to restrain them from so doing. Plaintiffs had had notice served on them, but now they said that these notices did not come to the knowledge of the general manager, or he would have sought to restrain the work.

Mr. Justice Phillimore: There is no equity in this matter. What we have to consider is not whether they have or have not stopped you before, but whether they have a right to stop you now.

Mr. Roskill argued that there must be an absolute right, not a suggested right, before plaintiffs could succeed on an interlocutory order like this.

Mr. Justice Phillimore: There must be serious mischief to be contemplated.

Mr. Roskill quoted the case of the North London Railway Company *v.* the Great Northern Railway Company in support of his

contention that unless the legal right was clear the plaintiff company could not get an interlocutory order. They had not that clear legal right here. The status of the Telephone Company was that conferred under Section 5 of the Telephone Act of 1892: "Where the Postmaster-General has licensed any company to transmit any telegrams [a term including telephone messages] he may authorise such company to exercise such powers as are conferred on the Postmaster-General during the time and within the area of the license." Defendants claimed to stand in the Postmaster-General's shoes, first by reason of this section, and then by the consent given by the Bristol Corporation.

Mr. Justice Phillimore: Yes; and now you have to show that the Postmaster-General can do this.

Mr. Mulligan: I do not for a moment contest that defendants have the rights of the Postmaster-General.

Mr. Roskill argued that the point turned upon the construction of Section 13 of the Telegraphs Act, 1863, and the question how far the liability cast upon a tramway company to keep their road in repair entitled them to keep others away from the soil beneath the tramway. Under Section 4 of the Act of 1878, plaintiffs could compel the defendants to go to arbitration. They had no power to withhold their consent absolutely. What possible damage could be done?

Mr. Justice Phillimore: My strong inclination, Mr. Roskill, is that you cannot base your case on Section 13; but I do not see why I should grant this injunction now. I can, of course, grant an injunction to restrain an apprehended or threatened trespass. You want your rights determined. Why should it not stand over until the hearing?

Mr. Mulligan: Defendants can have this point determined within 21 days if they will give us notice requiring our consent. This was a serious matter for the tramway company. They were about to adopt the use of electrical traction, and this was only one instance in many on various portions of the line.

Mr. Justice Phillimore: Defendants want their point decided.

Mr. Mulligan: Yes, but pending a decision, anything that defendants may do might greatly interfere with our traction.

Mr. Roskill: It would be at our risk.

Mr. Mulligan: Plaintiffs are in possession of this tramway. Defendants are seeking to disturb their possession. I submit it is not for the Court to take away possession from the party enjoying it.

Mr. Justice Phillimore: Really this is a question of the construction of the statute. It seems to me that there ought to be an order to expedite the case, and that it should be tried by a judge immediately after the long vacation, in the meantime there being no injunction.

Mr. Mulligan submitted that the injunction ought to continue.

Mr. Justice Phillimore: No; they must get their wires under these rails somehow or other.

Mr. Roskill mentioned that a summons had been taken out by defendants at Bristol, under Section 9 of the Telegraphs Acts, 1878, against the plaintiffs for obstructing them in the exercise of their work. If they could get an order on that summons, it might give rise to a special case, and the point would get to the Courts in that way, no doubt. The summons should be heard on the 29th of this month.

Mr. Justice Phillimore: Oh! is that so? If you are going to do that I shall let the authorities in Bristol know what is my opinion on the construction of the section. You had better withdraw that summons.

Mr. Mulligan repeated that it was a very serious matter for the defendants to lay their telephone wires under the rails when the tramway was about to be worked by electricity.

Mr. Justice Phillimore: You must give me an affidavit upon that. To prevent these telephone wires ever traversing the roadway, you know, is impossible. This is a public highway. It is not your close.

Mr. Mulligan: One system must, then, be so insulated as to be kept away from the other. I submit that in any case defendants ought to be put upon terms.

Mr. Justice Phillimore: Then I think it should be part of the order that defendants should, if at the trial the Court should be of opinion that they had no right to place these wires beneath your rails, submit to such restrictions as would be imposed by an arbitrator, if in the first instance they had gone to him?

Mr. Roskill said he would submit to that condition.

Mr. Mulligan: They must give us notice, and not interfere with our traffic.

Mr. Justice Phillimore: Yes, their work must be subject to that. I think you are delaying what will very likely be an important public improvement, and I cannot see that you are suffering any pecuniary damage, because your rights will be determined at the trial. In the very problematical event of the telephone wires doing you harm when you institute electricity on your tramways, you will be fully protected by the order that I shall make.

Mr. Roskill undertook to apply for leave to withdraw the summons taken out at Bristol.

Mr. Mulligan mentioned that for a week or 10 days the tramway company had had to keep a large staff of men watching these rails.

Mr. Justice Phillimore: I am going to save you that expense. His Lordship then directed that an order should issue that the defendants should apply to the stipendiary magistrate at Bristol for leave to withdraw the summons taken out under Section 9 of the Telegraphs Act, 1878, and should undertake, in the event of the judgment of the Court being in the plaintiffs' favour, to make such provision as might have been required of them if they had had to ask for leave in the first instance. Also the order would direct that the trial should be expedited.

Mr. Mulligan suggested that the action should be set down without pleadings. If the parties desired pleadings they might apply.

Mr. Justice Phillimore: Yes; and costs to be costs in the action.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Aug 16th, 1897.

	£	s.
Adelaide	136	0
Aden. Teleg. mat. ..	30	0
Alexandria. Teleg. mat.	238	0
Auckland	41	0
Bombay	151	0
„ Teleg. mat. ...	438	0
Boulogne	32	0
Brisbane. Teleg. mat.	438	0
Buenos Ayres	125	0
Calcutta	326	0
Cape Town	1,358	0
Christchurch	19	0
Cologne	25	0
Colombo...	21	0
Durban	39	0
Flushing	78	0
Genoa	8	0
Gibraltar	1,525	0
Hamburg	145	0
Malmo. Teleg. mat. ...	27	0
Malta	85	0
Melbourne. Teleg. mat.	1,536	0
Montreal	41	0
Napier	28	0
Newcastle	18	0
Port Elizabeth	29	0
Saigon	50	0
Santos. Teleg. mat. ...	716	0
Singapore	5	0
Stockholm. Teleg. wire	15	0
Sydney	275	0
Wellington	417	0
Yokohama	1,153	0
Total	£9,565	0

Week Ending Aug. 16th, 1898

	£	s
Adelaide	25	0
Alexandria	27	0
Antwerp	45	0
Bombay	23	0
Bordeaux	25	0
Boulogne	225	0
Buenos Ayres	9	0
Calcutta...	691	0
Cape Town	144	0
Colombo...	287	0
Demerara	9	0
„ Teleg. mat....	640	0
Dunkirk...	300	0
Durban	155	0
Halifax	350	0
Hamburg	280	0
Hobart	468	0
Melbourne	139	0
Paris	18	0
Penang	81	0
St. Petersburg	30	0
Shanghai	68	0
Sydney	157	0
Wellington	25	0
Total	£4,286	0

Acts Passed.—According to Tuesday's *London Gazette* the Royal assent has been given to each of the following Acts:—Electric Lighting Orders Confirmation (No. 5) Act, 1898; Electric Lighting Orders Confirmation (No. 7) Act, 1898; Electric Lighting Orders Confirmation (No. 8) Act, 1898; Electric Lighting Orders Confirmation (No. 15) Act, 1898; Tramways Orders Confirmation (No. 1) Act, 1898; Tramways Orders Confirmation (No. 3) Act, 1898; Sheffield Electric Lighting (Transfer) Act, 1898; Portsmouth Corporation Tramways Act, 1898; Devonport and District Tramways Act, 1898; Chelsea Electricity Supply Act, 1898; Metropolitan Electric Supply Company Act, 1898; London United Tramways Act, 1898; Whitechapel and Bow Railway Act, 1898.

Annual Outing.—The fourth annual picnic of the employés of the Chloride Electrical Storage Syndicate, Limited, took place on Saturday, July 30th, at Worksop. After breakfast a drive of 25 miles through the beautiful estates of the Dukeries was taken. After a stay at Edwinstowe the drive was resumed, and an excellent dinner was provided at Worksop at 6 p.m.

British Investments in Turkey.—The *Financial News* Berlin correspondent says that it is reported there that Sir E. Ashmead-Bartlett, M.P., who was staying recently in Constantinople with a view of obtaining from the Porte certain electrical concessions, has been advised to endeavour to come first to an understanding with the important German electrical concerns. Sir E. Ashmead-Bartlett has, indeed, been in Nurnberg and several other German towns—it is understood for the purpose of carrying on negotiations with the German electrical companies. So far, however, there is no news of any practical result having been obtained.

Books Received.—"The Mechanical Engineer's Handy Office Companion," by Robt. Edwards, M.I.C.E. London: Crosby, Lockwood & Son.

"Distribution de l'Energie par Courants Polyphasés," par J. Rodet. Paris: Gauthier-Villars. 8 francs.

"Introduction to Algebra," for the use of secondary schools and technical colleges, by G. Chrystal, M.A., LL.D. A. & C. Black, Soho Square, W. 5s.

"Practical Magnetism and Electricity," by J. Reginald Ashworth. London: Whittaker & Co.

Berchem's Automatic Steam Cylinder Drain Valve.—Messrs. W. H. Wilcox & Co., Limited, of Southwark Street, S.E., have lately introduced this new valve for the purpose of providing a reliable draining attachment and allowing for the regular escape of water in the steam cylinders. For this apparatus it is claimed that owing to the few working parts there is nothing to get out of order. The steam losses, especially where the ordinary cylinder drain cocks are used without a steam trap, are so numerous that anyone who counts the actual cost of power under such conditions can realise that the application of a reliable and efficient automatic drain valve is becoming a necessity. Various iron works, mills, &c., in all parts of the United Kingdom, as well as on the Continent, are using this valve successfully. To obtain good results it is essential that the drain valve should be placed above the steam trap into which it has to discharge, so that the water may run into trap by gravity. This draining attachment is so constructed, that when starting the engine,

steam pump, or whatever it may be applied to, it allows of an uninterrupted discharge of all condensed steam, and the valves do not close until the live steam attempts to pass. They will automatically open to allow even the smallest quantity of water to pass. It can also be applied to pipes in connection with heating apparatus.

Catalogue.—Messrs. Davies, Kent & Stewart, of 17, Berners Street, W., have issued a well-arranged catalogue (35 pages) detailing, pricing, and illustrating various electric light fittings (lamps, switches, sockets, cut-outs, fuseboards, switchboards, &c.), also the necessaries for electric bells.

Dissolution of Partnership.—Messrs. F. Cammann and F. Pendergast (Cammann & Pendergast, electrical engineers, 23, John Bright Street, Birmingham), have dissolved partnership by mutual consent.

Electrical Department.—Mr. Fred. Swindells, plumber, &c., has added an electrical department to his business in Blossoms Street, Stockport.

Electrical Engineering in Mexico.—The Municipal Council of the City of Mexico has granted permission to the Société de San Ildefonso to erect overhead conductors in the public streets in connection with the plant it is putting down to supply electrical energy for power purposes.

Electrical Omnibuses.—It is stated that it is in contemplation to establish a service of electrical omnibuses between Winchester and the Wortheys, a group of charming villages in the suburbs of Winchester. The road has already been surveyed, and as there is constant communication between these places the venture should prove successful. The generating power will be obtained from the new electric works in Hyde Abbey Road. In the event of success it is stated that the service will be extended to other places in the vicinity of the city.

G. B. Unsworth & Sons, Limited.—Mr. G. B. Unsworth, electric wire manufacturer, of Green Lane Mills, Derby, informs us that he has converted his business into a private limited company under the above name. The conversion has been effected partly for family reasons. All debts and liabilities of the firm are undertaken by the company and all debts due to the firm are to be paid to the company. All the shares are held by those interested in the late firm, and the conversion will not affect the general conduct of the business.

Hull Technical Schools.—The Fuller-Wenström Electrical Manufacturing Company inform us that they have received the order for the whole of the electrical machinery for the new municipal technical school at Hull.

Liquidation Notices.—Meetings of the Esson Motor, Limited, were held on July 12th and August 5th, at 8, Old Jewry, E.C., when it was resolved to wind up voluntarily, and appoint Mr. J. C. Macgregor, of that address, liquidator.

Military Tattoo.—The Electrical School attached to the Chatham School of Military Engineering, which has its headquarters at St. Mary's Barracks, Brompton, was responsible for the brilliant electrical display which took place at Chatham on Wednesday evening last week, the occasion of holding a massed military tattoo, under electric light and torches, at the Chatham Football Grounds, Maidstone Road. It is believed that there were at least 7,000 spectators of this grand military display. Electric arc lights were fixed in the grounds, and the great electric search lights from the military embattlements were every now and then brought into operation. The electric lighting operations were under the supervision of Sergt.-Major Burton, Royal Engineers, and Lieut. Dumaresque (the instructor in electricity at the School of Military Engineering) was one of the committee.

Motor Car Exhibition.—At the Royal Agricultural Hall, Islington, next Monday, will be opened, under the management of Mr. Charles Cordingley, an exhibition of over 100 British and foreign motor cars, driven by steam, petroleum, and electricity.

New Works.—Mr. Bannister, an electrical engineer, has, according to the *Crawley and Horsham News*, just bought a piece of land at West Green, Crawley, on which he intends to build motor car and general engineering works.

Our Trade with Russia.—So much has been written about the great harm done to our trade by the engineers' strike, that galling as it may be, we are not surprised to read the following paragraph in our St. Petersburg Consul's report upon the foreign trade of Russia for the past year:—"Owing to the recent engineers' strike in Great Britain, a great many orders for railway locomotives, electric plant, and other machinery went to Germany and the United States; in this way great injury was done to the British industrial interests in this country and the success of our rivals furthered. As a case in point, the Finnish Railway Company, which had always previously supplied itself with locomotives of British make, gave an order for 20 powerful locomotives to American builders, seeing that it could not rely on the execution of the order within a reasonable time in England in consequence of the strike." Yet we learn that the importation of spinning, agricultural, and electrical machinery into Russia took place in greater quantities than the previous year. We have at present over 21 per cent. of the total export trade of the Russian Empire, and 18·6 per cent. of the import trade. But our Consul-General thinks that British exports to Russia might be increased, within certain limits, by increased activity on the part of commercial travellers properly equipped.

Receiving Order.—A receiving order was made on 12th inst. in the Bankruptcy Court on a creditor's petition, in F. W. Henton & Co., lately carrying on business as electrical engineers at 24, King William Street, Strand, W.C. The first meeting will be held at Carey Street, W.C., at 12 noon on August 25th, and the date of the public examination is October 11th, at 11.30 a.m.

Release of Trustee.—Tuesday's *London Gazette* contains notice of release of trustee (official receiver) in the case of G. F. Lee, electrical engineer, Wandsworth Bridge Road (Lee & Hancock, Sydney Street, Chelsea). The date of the release was June 29th.

Steel Conduits.—The Simplex Steel Conduit Company, Limited, of Birmingham, have opened a London office and warehouse at Mansion House Chambers, 20, Bucklersbury, E.C., where it is intended to keep a stock of their conduits and accessories. They have also appointed Mr. E. Sheppard, late electrical engineer to the Peninsular and Oriental Steam Navigation Company at the Royal Albert Docks as their London representative. The company, owing to the very large demand for their steel conduit system, are more than doubling their present plant throughout.

The "Industry" Lamp.—Messrs. Lotz, Abbott & Co., of 66, Queen Street, E.C., send us a circular detailing the advantages claimed for the new "Industry" electric incandescent lamp, of which they are sole agents.

The National Electric Free Wiring Company, Ltd.—This company has opened capacious branch premises in Guildhall Street, Lincoln, where numerous orders are being booked from local ratepayers preparatory to the municipal institution of electric lighting works. Already the buildings have been erected and the machines, boilers, &c., fixed, but up to the present only about half of the cables have been laid, and it would be about January, or perhaps earlier, before the current will be supplied.

To Creditors.—Creditors who have claims against the estate of the late Mr. James Morris, of the Electric Light Works, Branksome (who died in July, 1897), should send particulars before August 30th, 1898, to Mr. John Paillips, florist, Seamoor Road, Westbourne.

Water Power.—A German firm lately obtained a concession from the Servian Government to exploit the water power of the Danube at the Iron Gate by establishing different industrial concerns to be worked by electricity. Work had hardly been started, however, when the Hungarian Government stopped it, declaring that Servia had no exclusive claim on the water power, and that an International Commission must decide to what degree each of the two countries might make use of it.

ELECTRIC LIGHTING NOTES.

Alton.—Mr. A. J. Nash, of South Street, Farnham, intends applying for a provisional order authorising him, or a company to be formed for that purpose, to supply electricity throughout the Alton rural district.

Ashbourne.—The District Council has agreed that no generating station for electricity should be placed in the paddock or the land adjoining it.

Ashford.—The Urban Council will hold an extraordinary meeting on September 7th for the purpose of passing a resolution of their intention to apply for a provisional order.

Ashton.—The Town Clerk has been instructed to write to the neighbouring local authorities inquiring whether, in the event of the Corporation promoting a Bill in Parliament authorising them to take a lease of electric lighting, &c., powers outside the borough, the outside authorities would be willing at the same time to apply for provisional orders under the Electric Lighting Acts. It was also resolved to ask, on the necessary powers being obtained, whether such authorities would be prepared to enter into an arrangement for the Corporation to supply electrical energy in their districts, either to the authorites wholesale, or to consumers direct.

Asylum Lighting.—At a recent meeting of the governors of the Richmond District Lunatic Asylum, held at Grangegorman, Dr. Norman read a report of the committee of the whole house which recommended the lighting of the whole asylum by electricity. Mr. Crozier said this would effect a saving of £600 a year. The report was adopted.

Bristol.—At last Friday's meeting of the Electrical Committee a number of electrical extensions were agreed to. Application for current for power purposes at the Granary was considered, and it was decided to lay cables if the Granary ultimately decided to work by electricity. The cables will be carried all along the Quay from Bristol Bridge to the Granary, and it is expected that many lifts and other power appliances will take their supply from these mains. The extension to the new rope works about to be put down by Messrs. Terrell, at Arno's Castle, Brislington, was considered, and it was decided to lay power mains provided the rope works would undertake to receive the power for a stated number of years. It was also agreed to extend the mains to the Wesleyan Chapel in Victoria Street, Bedminster, and they will be extended *viâ* North Street if any other applications are forthcoming in the district. The Committee

decided to extend the mains to Worcester Crescent, College Road, Clifton, and also to Lower Castle Street. It was reported that the Employers' Liability assurance had been placed with the Ocean Accident Assurance Corporation.

In Bristol the demand for the electric lighting supplied by the Corporation is increasing, and the results of the installation have been most satisfatory. Applications come not only from within the area of the recently enlarged city, but also from over the borders, in districts which successfully opposed their inclusion in the Greater Bristol. For some time gas has long been supplanted in most places of business and large establishments, and in other places the change is being gradually effected. In Clifton, too, mains are being laid for supplying private residents, who have made applications in large numbers.

Buxton.—The Electric Light Committee recommends that £20,000 be raised for electric lighting works.

Canterbury.—It is suggested that the National Electric Free Wiring Company should be invited to extend its operations to Canterbury.—A few extracts from the report presented at the Town Council meeting held last week by the consulting engineer, Mr. R. Hammond, M.I.E.E., may be interesting. He had found the use of bricks for covering the cables less costly than with wood, and therefore recommended bricks in preference to wood. Mr. Hammond estimated the present number of applications received for the supply of current represent the equivalent of about 2,200 8-C.P. lamps, and this, with the extra lamps for public buildings and street lamps, would bring up the total capacity immediately wanted to 97 kilowatts. The working capacity of the plant at first provided would be 150 kilowatts, but the popularity of the whole affair among the citizens has led him to make the buildings for the generating plant of a sufficient size so as to enable additional machinery and alterations, in order to allow of an additional capacity of 150 to 200 kilowatts being put in.

The electricity works' boiler house plant and buildings are to be enlarged owing to the large number of applications which are being received for the electric light.

Carnarvon.—The other day a company gave notice to the Corporation that they intended to apply for powers to illuminate the town with electricity, but the Corporation decided to oppose them, and also decided not to go in for powers themselves. A correspondent says that the reason for this is that the Carnarvon people are clannish, and own their own gas works.

Cardiff.—The Corporation Lighting Committee held a special meeting last Friday to reconsider the tenders submitted for the supply of a steam alternator. It will be remembered that the matter had been before the Council on the previous Monday, when it was referred back to the Committee. At the Committee meeting Alderman Carey presided. He referred at some length to the statements made at the Council meeting in respect of the locality where the machine previously recommended was made, remarking that if these statements prevailed against the personal experience of members who had witnessed its manufacture, the only thing to do was to call in a consulting engineer. It was a pity that the Committee was divided; and even if they agreed there were certain reasons why the Corporation would probably upset the findings of the Committee, and meanwhile the town suffered.—Councillor Andrews, referring to the suggestion of the chairman that an expert should be called in, said that their experience of experts in this department in the past had not been satisfactory, and before making a motion he would like to ask Mr. Appelbee whether, if they accepted Messrs. Siemens's tender for £3,130, the machine would be satisfactory. The electrical engineer replied that subject to a slight alteration Messrs. Siemens's machine was perfectly satisfactory, and in respect of the modification in question they had verbally promised to effect it.—Councillor Andrews thereupon moved that, subject to the approval of the electrical engineer, Messrs. Siemens's tender be accepted, and Councillor Brain seconded.—After further discussion, Councilor Illtyd Thomas moved that the tender of Messrs. Ferranti be recommended for acceptance, and Councillor Hallett seconded.—In reply to questions, the electrical engineer said it was a splendid machine with the exception of the valving. Upon a vote being taken, the amendment that Messrs. Ferranti's tender be accepted was defeated by three to two. After further discussion the motion in favour of Messrs. Siemens's tender was carried by the chairman's casting vote.

Last week a Local Government Board inquiry was held *re* the Corporation's proposal to borrow £500 (?) for electric light extension purposes. The inspector afterwards visited the streets where lamps are to be erected and new mains laid.

Coatbridge.—At the Town Council meeting on Thursday last week, a letter was read from the House-to-House Electricity Company, Limited, who have the contract for lighting some of the lamps of the town with electricity, in answer to one from the Town Council, stating that the directors of the company felt that the yearly contract for such a small number of lamps sometimes leads to an expenditure of capital upon which no adequate return is to be had at the price paid, and that the amount paid on eight lamps hardly gave them the working expenses. They asked the Council to enter into a contract for a term of seven years for a minimum number of 10 lamps, for which they would continue their present price of £21 5s., but if the contract be from year to year the minimum price for eight lamps would be £22 10s. The Fire and Lighting Committee recommended that the Council do not accept the company's terms, and that the Provost and Councillor Smellie should have full powers to make the necessary arrangements for the lighting of the streets by gas or electricity. Ultimately it was agreed to remit the matter, with powers to the Committee, to negotiate further with the electric light company.

Cheltenham.—The Lighting Committee recently received notice, on behalf of Mr. Martin Rucker, of an alleged infringement of patent in its sub-station method of transforming current.

Colwyn Bay.—The electric lighting of the new promenade was inaugurated on Tuesday evening by a dinner given by Messrs. Biggs & Thomas, the contractors under the Urban District Council. The light was switched on by Mrs. Herbert Roberts, the wife of the member for Denbighshire.

Falmouth.—The Corporation will oppose application proposed to be made by a company for a provisional order.

Fletton.—The Parish Council of Fletton, a suburb of Peterborough, has been discussing the question of electric lighting, and one of the large brickyard firms of the place is to be asked to give a quotation on what terms they would be prepared to light the whole of the streets.

Garston.—A Local Government Board inquiry is to be held shortly *re* the Council's application to raise £25,000 for electric lighting and refuse destructor purposes.

Hampstead.—The Board of Guardians has instructed Messrs. Massey & Allpress, consulting electrical engineers, to proceed at once with the preparation of their specification for wiring for the electric light the new buildings recently erected at the Workhouse.

Heywood.—The Town Council has resolved to obtain a provisional order for electric lighting.

Hornsey.—At Monday's meeting of the District Council, the Lighting Committee reported the receipt of a letter from the Urban District Councils Association, enclosing a copy of a resolution passed at the conference at Matlock Bath, to the effect that the principles approved in the recent report of the joint committee on Electrical Energy (generating stations and supply), and adopted in the Bill promoted by the General Power Distributing Company, now before Parliament, were seriously prejudicial to the interests of local authorities, and the conference recommended authorities interested to communicate with their Parliamentary representatives to secure the rejection of the Bill. It was decided to take no action at present. The same committee reported that the Electric Lighting Order Confirmation (No. 3) Act, 1898, including the Hornsey Electric Lighting Order, 1898, had received the Royal assent.

Hotel Lighting.—The new hotels of the Midland Great Western Railway of Ireland are both well lighted electrically. At the Mallaranny Hotel, water-power obtainable in the neighbourhood is used for the purpose.

Ilkeston.—The Town Council has appointed a Tramways and Electric Lighting Committee.

Johnstone.—The Electrical Power Distribution Company, Limited, of London, have asked the Town Council to assist them in procuring a provisional order for electricity supply. The letter will lie on the table.

Kirkcaldy.—According to a provincial paper, the scheme for the introduction of electric lighting and traction into the town has now assumed an aspect that points to a private company taking it in hand. It is stated on good authority that the Town Council will not take up the scheme, but they will be very urgently requested to support the local company in preference to any outside combination.

Leamington.—The General Purposes Committee has appointed a committee for the purpose of considering the position of the Corporation with regard to the electric lighting question.

Leigh.—Mr. W. O. E. Meade-King has held a Local Government Board inquiry into the Council's application for sanction to borrow £10,500 for electric lighting. Mr. Thomas, clerk to the Council, stated that it was proposed at present to light only the compulsory area, and works would be erected on the gas works' land, saving the cost of boilers and chimney stacks. The engineer estimated that the plant would be sufficient for five years ahead. The system will be a continuous current direct supply at constant pressure on the three-wire system, the intermediate conductor being, with the approval of the Board of Trade, connected with earth at the generating station, but insulated at all other points. The mains will be lead-covered cables, the feeder mains being concentric, and drawn into stoneware conduits under footways and into iron pipes under roadways, and the distributing mains being three-core cables, laid in stoneware troughs filled in solid with bitumen cement. A canvass shows that about 4,000 8-C.P. lamps would be required immediately. Street lighting is not at present contemplated. The total capacity of the proposed plant would give out sufficient energy to supply 6,600 8-candle-power lamps lighting at one and the same time. It was estimated that only about 2,000 lamps would be required to be lit at one time. The Council were fortunate in having the site of the works in such a position that the compulsory area was within half a mile of the generating station. It was anticipated that this instalment would even pay in the first year, having regard to this fact and the savings he had mentioned.—The Inspector: Rather sanguine.—Mr. Thomas said it was not an unknown thing for works to pay in the first year. The total cost of the working for one year was £1,240. That included the payment of interest at 3 per cent. on the capital, at 25 years' repayment. The estimated receipts from consumers, at 5d per unit, allowing 5 per cent. discount, were £1,251 9s. 1d. The cost of the order was £284. The proposed pressure was 440 volts, and the number of accumulators 280. The system adopted would be adaptable for power and traction purposes.

London, E.C.—It is stated that the City of London Electric Lighting Company proposes introducing a system of free wiring, charging a rental for the capital outlay.

Lynn.—At the last Council meeting considerable discussion took place on the question of electric lighting, initiated by Mr. Parsons, who was desirous of delaying the carrying out of the scheme on the ground that it was not likely to be a financial success; but the Town Clerk ruled that as no notice had been given to rescind the resolution authorising the scheme to be carried out, it was impossible to vote on any proposition that might be made. It was understood that steps would be taken to have a special meeting on the subject.

Manchester.—The General Electric Company, Limited, have just got settled down in their spacious new premises at Victoria Bridge, Manchester. The frontage is an imposing one, and there is all the equipment for a large business.—The Salford Corporation have publicly intimated that they cannot consider any further applications for the supply of the electric current until February, 1899.

Margate.—The Margate Town Council have approved of the draft agreement for the transfer of the electric lighting order of the Corporation to the Isle of Thanet Light Railways (Electric) Company, subject to the insertion of a clause stipulating that all the buildings and plant for the generation of electric light are in the borough of Margate.

Maidstone.—The District Council has resolved: "That competitive designs for a combined electric station and dust destructor on the lines of the Shoreditch system be advertised for; such designs to be submitted to Messrs. Kincaid & Co., as assessors."

Middlesbrough.—The Corporation will, if it adopts the Electric Light Committee's recommendation, oppose the application of the Electric Power Distribution Company for a provisional order.

Mexico.—Further copies of the *Two Republics* which have come to hand, contain additional complaints of the failures in the street electric lighting. On one occasion, owing to the darkness, a man was run over by a street car, and our contemporary writes about the necessity of some improvement being effected in the lighting service.

Mirfield.—It has been decided to oppose the applications of companies for electric lighting powers, and the Council will itself apply for a provisional order.

Moss Side.—The District Council has decided to write to the Manchester Corporation urging the adoption of the electric light in the Moss Side district, and that tenders be obtained for the electric lighting of the Council offices.

New Zealand.—Some weeks ago Messrs. W. Crosher and Sons submitted to the Auckland City Council an electric lighting scheme for the inner area of the city of Auckland, prepared by Messrs. Crompton & Co. The scheme detailed the estimated outlay, probable number of lights required, &c., but the Council has had proposals before it before, and resolved again on this occasion to reply that it was not at present prepared to entertain the proposal.

Oldham.—At Wednesday's meeting of the Gas Works and Electric Lighting Committees, Mr. Arthur Andrew, gas and water superintendent, presented his report with regard to the recent explosion. He stated that at about 10 o'clock on the night of the 11th inst., an explosion of gas occurred in Bottom o' th' Moor, by which the electric light culvert between the Red Lion Hotel and Cross Street (a distance of 54 yards) was damaged, and the footpath disturbed. The cause was a leak in the gas main at the corner of Hall Street, the gas getting into the electric light culvert. The gas was ignited by a spark from the switch in the lamp-post at the corner of Cross Street when the light was being extinguished. The work of repair was commenced shortly afterwards, and was so far completed the following day as to allow current to be again supplied in the immediate vicinity and the district beyond. The man who was turning out the light, and a girl who happened to be on the footpath at the time, were thrown down, and the latter sustained a slight injury, principally from shock. No damage was caused to the adjoining property. In the course of the discussion, Mr. Andrews said he had arranged with Mr. Newington, the electrical engineer, to make periodical inspections of the culverts. The leakage of gas was 120 yards away from the point of the explosion, and where the ignition took place. It was decided to leave the matter over for further consideration, in the meantime the culverts to be examined periodically.

Pemberton.—The District Council last week decided to advertise for electric lighting schemes, but without offering a premium, as had been previously proposed in committee.

Penistone.—A representative of a local firm of electrical engineers recently waited upon the District Council with regard to electric lighting for the streets. The matter was adjourned.

Perth.—The Electric Light Committee has decided to communicate with the different companies offering to undertake the introduction of the electric light into Perth as to their terms and conditions.

Port Glasgow.—An application by the North British Electricity Supply Company for electric lighting powers will be opposed by the Town Council.

Petersfield.—At the Urban District Council meeting last week the Lighting Committee reported in favour of applying to the Board of Trade for a provisional order for electric light, and the vice-chairman (Mr. R. G. Cross) gave notice that he would move a resolution to that effect on the 22nd prox.

Portsmouth.—At the last meeting of the Town Council it was reported that a letter had been received from the testing officer with reference to the cost of, and time occupied in, removing and testing electricity meters, and the recommendation of the Committee that the charge for testing meters removed from consumers' premises be 3s. 6d., instead of 2s. 6d., was adopted. The Finance Committee reported that they offered no objection to the expenditure of £100 by a committee to visit other places for the purpose of ascertaining the best system of traction to be adopted for the working of the tramways. It was urged that the expenditure would be wilful waste, but on a division an amendment to defer the matter for three months only found five supporters, and the report was adopted by 24 to 9. At the same meeting the Electric Lighting Committee submitted a draft agreement with the National Electric Free Wiring Company, with a recommendation that it be approved and the common seal affixed thereto. Mr. Murtough, in moving the adoption of the recommendation, said it was anticipated that if the agreement was entered into, thousands of residents in Portsmouth would use the electric light who would never do so if they were compelled to pay a lump sum for the fittings. The system had been adopted at Blackpool, Taunton, West Ham, Worcester, and St. Leonards, and by several electrical supply companies, &c., and in every instance it had been a success. There was a feeling that it might interfere with the legitimate business of tradesmen, but he could not see it, and even if it did he maintained that it was not the duty of the Council, for the sake of individual interests, to stop the progress of the electric light, as they had at the station machinery equal to thousands of lights more than they were now supplying. The objection to the proposal was led by Mr. James Bishop, who said he did not oppose the company coming to Portsmouth, but the Corporation joining hands with the company to collect the monies to pay the rent. It would not be a free wiring company, because they would charge people one-sixth more for the electricity. It would be a sort of hire system, as he understood it. As far as the Corporation was concerned, it had no right to bring a company there to interfere with local tradesmen. The ex-mayor (Mr. G. E. Cousens) said it was due to local tradesmen that the electric light had been such a success. He believed the opinion of outsiders was that to introduce the scheme was to attempt to foist a company on the town for the benefit of a few persons. In the course of further discussion, it was stated that Alderman G. Ellis, chairman of the Electric Lighting Committee, was a director of the Free Wiring Company, and it was urged that it was sought to make an agreement between the company and the Corporation which would give an absolute monopoly to the company. In clause 5 of the proposed agreement, the company stated that they would make no charge against the Corporation, but it was contended that they ought to pay the Corporation £3,000 or £4,000 for giving them the monopoly.—On a division, an amendment to defer the matter for a month was rejected by 17 to 6, and the motion for the adoption of the Committee's recommendation found only three supporters, 21 members voting against.

Rhyl.—At the request of the General Purposes Committee Mr. Buddicom is to draw up a scheme for electric lighting.

Ripley.—At the last District Council meeting a member said that Belper was far in advance of Ripley in the matter of gas, and he suggested that the quality of the gas supplied during the coming winter should be tested, and if not improved by spring, that the Butterley Company or some other be asked to supply the electric light.

Rugby.—The Council has refused consent to the application of the Urban Electric Supply Company, Limited, for electric lighting powers.

Runcorn.—The District Council has resolved that application be made to the Board of Trade for a provisional electric lighting order.

South Shields.—The new "Redhead" wing of the Ingham Infirmary is being wired for electric light. The work has been entrusted to Mr. J. T. Dagleas, of South Shields.

Stirling.—The Police Commissioners had before them some days ago a minute of the Lighting Committee recommending that the negotiations in connection with the scheme for the electric lighting of the town by water-power should cease. The minute was adopted, and it was remitted back to the Committee to carry out their previous instructions in connection with Prof. Kennedy's steam-power scheme. Mr. Yorke's scheme having now been abandoned, the Committee will proceed at the point they had arrived at when that gentleman was called in.

Stockport.—The Gas and Electric Lighting Committee is forming an insurance fund with respect to the Workmen's Compensation Act. The area authorised under the provisional order is to be extended to that covered by the present gas powers, and the necessary steps to that end are being taken.

A scheme recently submitted by the chairman of the Gas and Electric Lighting Committee, Councillor Thomas Webb, for lighting various streets in the centre of the borough by means of 36 arc lamps, made up of nine circuits of four lamps each, at an estimated capital expenditure of £1,125, has been adopted. The maintenance and energy for the installation were estimated at £468, against £452 for

gas, or an increase of £17 per annum for the area dealt with. The illuminating power of the proposed installation would be 24,000 candles, against 2,463 candles for gas, as at present, being an increase of 21,538 candles, or allowing for the concentration of light in the arc lamps, illuminating power equal to five times the power of the present gas lamps.

Taunton.—The electrical engineer (Mr. E. B. Thornhill) reports that during the past quarter there had been connected to the mains the equivalent of 1,210 8-C.P. lamps, and there was still a large number on order.

Wakefield.—The Gas Company is now to remove the public gas lamps from a number of thoroughfares.

Whitechapel.—The Electric Light Committee has asked the District Board for instructions to clear the site recently purchased for electricity works.

Whitehaven.—At the meeting of the Town Council on Wednesday, it was decided to promote a Bill in Parliament next session for the purpose, amongst other things, of extending the electric light area of the borough. At the same meeting it was also decided that the application to the Local Government Board for power to borrow £7,500 for extending the electric lighting station should be increased to £12,000, owing to the recent purchases of adjoining property. The Town Council also accepted the following tenders for stores:—Electricity meters, Messrs. Chamberlain and Hookham; dynamo spindle oil, gauge glasses, Messrs. Ramsay Bros.

Winchester.—Among the first of the public institutions to adopt the new illuminant is Winchester College, where, during the vacation, the electric light is being installed.

Windlesham.—The Electric Works Company, Limited, is negotiating with the Parish Council with a view to including Windlesham in its provisional electric lighting order.

Withington.—Last Friday's *London Gazette* contains notice of the transfer of the Withington District Council provisional order to the Manchester Corporation, also the conditions.

Yarmouth.—The Town Council considered, on Tuesday, a letter from the solicitors to Mr. M. D. Rucker, alleging that the Corporation had infringed certain letters patent with respect to an invention for improvements in distributing electricity and apparatus therefor. Damages were claimed, and an undertaking sought that the Corporation would cease to use the invention until they had obtained a license. It was stated at the meeting that some 60 other corporations had received a similar notice and claim. The Council resolved to repudiate all liability, and instructed the Town Clerk to co-operate with the several corporations affected, with a view to joint action in the public interest in regard to this matter.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Belfast.—The Tramways Company has replied to the Joint Electric and Law Committee. It finds it impossible to give practical consideration to the heads of proposal in regard to electric traction without being supplied with further details, such as the definite amount to be paid by the company in respect of the funds to be expended by the Council, and also in respect of the depreciation of the plant. The Committee, however, do not feel that they would be justified in filling in the blanks in the heads of proposal, and committing the Council, until the directors of the company would say if they accept the principle involved in the proposals of the Corporation as a basis of settlement before entering into the details, and on learning whether the company would agree to this preliminary, the Committee would then proceed with the negotiations in the manner suggested by the directors.

Bootle.—A deputation from the Bootle Corporation last week waited upon the Tramways Committee of the Liverpool Corporation to obtain some information *re* electric traction. The deputation represented that the Bootle Corporation desire to be informed how soon, approximately, it will be before electric cars will be run in Bootle. Their electric installation, they stated, will be at work before the present year is out, and they will be prepared to supply energy for the cars as soon as required. They are desirous that an electric service may be established between Bootle and Liverpool as soon as possible. The Bootle Corporation are of opinion that the Stanley Road line is one of the best in the district for electric traction, and they suggest it should be taken in hand at an early date. The chairman of the Liverpool Tramways Committee informed the deputation that the Liverpool Corporation were desirous of giving Bootle a service of electric cars as soon as practicable, but this could not be done until their experimental line in Liverpool had been tested, and that the experimental line would not be ready for use before October next. The Committee agreed with the deputation that the Bootle route was a suitable one upon which to give an early trial of the system of electric traction, and the chairman promised that the request of the deputation should be borne in mind and given effect to as far as possible.

Bradford.—Alderman Cowgill (chairman of the Tramways, Baths, and Team Labour Committee) stated at the last City Council meeting that the new electric line had been worked 10 days, and 2,859 miles had been run. The total receipts up to Monday night were £232 7s. 9d., an average per car mile of 1s. 7¼d., which, he thought, would be very satisfactory if it could be kept up, leaving no fear of a deficiency. The heaviest receipts per car mile were one Sunday, amounting to 2s. 6d. But there was only a quarter of an hour's service on that day.

Dublin and Lucan.—The report of the directors of the Dublin and Lucan Steam Tramway Company states that it will not be possible to pay a dividend on the ordinary shares of the company until the electrical equipment of the line shall have been completed. An Order in Council, authorising the line to be worked electrically and for the execution of the necessary works, was made on December 16th, 1897, and a contract has since then been entered into with Messrs. Dick, Kerr & Co., of London, for the execution of the greater portion of that work, which the directors will spare no effort to have finished at as early a date as possible.

Dublin.—The following paragraph appears in the half-yearly report of the Great Northern Railway Company (Ireland):—"The arrangements for obtaining possession of the land necessary for the construction of the electric tramway round the Hill of Howth are well advanced. The working plans for the line are completed, and tenders will shortly be invited for the carrying out of the work. The Bill deposited in Parliament to incorporate a company for the purpose of constructing a tramway from Clontarf to Howth has passed both Houses of Parliament."

Leeds.—At the meeting of the Highways Committee of the Leeds Corporation on Friday last, the recommendation of the Tramways Committee to let the contract for the supply of 50 new electric cars to the British Thomson-Houston Company was adopted. It was originally decided to recommend the tender of Messrs. Dick, Kerr & Co., of Glasgow, at £468 10s. per car, but that was rescinded the following day. The equipment which the Thomson-Houston Company propose is similar to those now in use in Leeds, and giving general satisfaction. The price is £531 10s. per car, and a dozen have to be delivered within the next four months.

Leicester.—The chairman of the Leicester Tramways Company informed the shareholders last week that negotiations are proceeding with the Corporation for the purchase of the undertaking. We presume, therefore, that it will not be long ere the question of mechanical (meaning, of course, electrical) traction is considered here.

Light Railways.—The attempt to construct a light railway to Beamauris having failed, it is on the tapis to construct one through the agricultural district from Amlwich to Valley, in Anglesey. The Anglesey County Council are in favour of the principle, but it is not at all improbable that they will themselves seek power to cover the island with quite a network of light railways, independent of what private capitalists may do.

The Light Railway Commissioners will hold an inquiry at Portmadoc on September 26th, into the application of Messrs. A. Bromwich, R. Davies, and D. Morris, for an order to authorise them to construct a light railway between Portmadoc, Beddjelest and Snowdon.

We understand that the Board of Trade has finally sanctioned the construction of an electric trolley light railway line between Margate and Ramsgate by way of Broadstairs.

The Board of Trade have, after modification, confirmed an order made by the Light Railway Commissioners, authorising the construction of light railways at West Hartlepool.

The promoters of the St. Just, Newlyn, and Penzance light railway are stated to have dropped the portion of their scheme to which the chief opposition was offered. The proposal was to work the line from St. Just to Newlyn by steam, and from Newlyn to Penzance by electric traction. The route was along the Penzance Promenade Road, and this the Corporation decided to oppose. The Madron District Council were also opposing the laying of the line along the Newlyn Green Road. In consequence of the attitude of these local authorities it has now been decided to drop that portion of the scheme altogether, and the application to the Commissioners, so far as that proposal is concerned, will only be for a railway having its terminus at Newlyn Harbour.

Rochdale.—A deputation representing the Rochdale Corporation visited Bradford on 11th inst. for the purpose of inspecting the new electric tramway and the electricity works.

Sheffield.—The trolley poles of the Nether Edge and Tinsley electric tram line are now being erected.

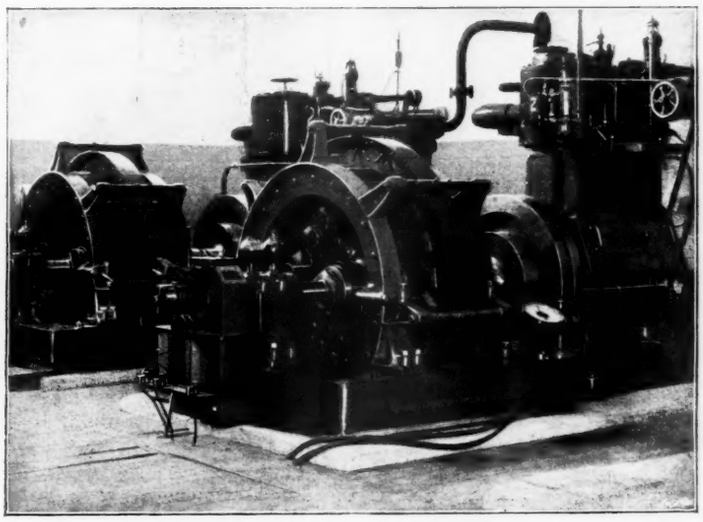
The Central London Railway.—According to the *City Press*, the contractors for the construction of the new line from Shepherd's Bush to the City on Monday commenced the construction of an air-lock at the Davies Street station, near Oxford Street. The chairman, at the recent meeting of the company, referred to the difficulty of tunnelling at this point, where the work of driving the tunnel necessitates the use of compressed air. This has been occasioned by the excavation coming into contact with one of the rivulets of the London of bygone times. Rapid progress has been made with all branches of the work, and it is now possible to walk along the line from Chancery Lane to Davies Street station.

(*Continued on page 277.*)

CHARTERS TOWERS (QUEENSLAND) ELECTRICITY WORKS.

Though this small station presents no new features in electricity supply, still it may possess points of interest to many of our readers, in so far that it shows the advancement of electricity in our more distant colonies, and also that even in small towns it is possible to put down a central supply station, constructed on the most modern lines, and the same may be made to pay if run on a proper and economical basis.

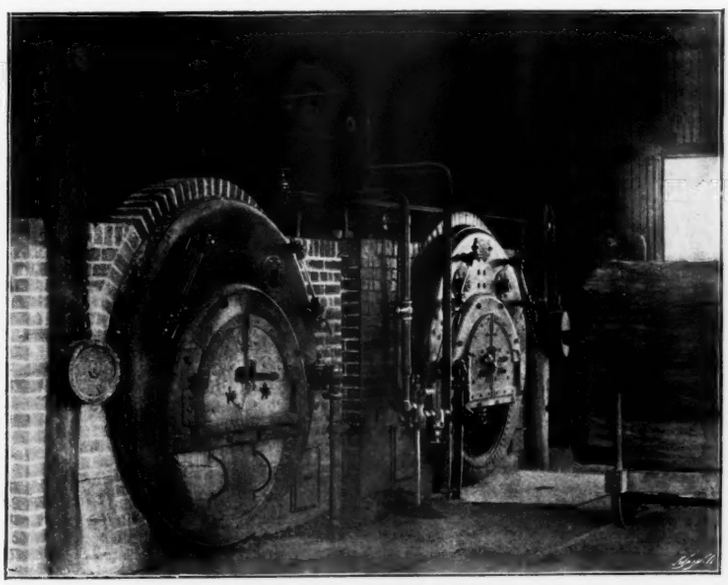
The town of Charters Towers, situated in North Queensland, Australia, is a large gold mining centre of about 20,000 inhabitants; but it presents serious difficulties to economical electricity supply, owing to its being so scattered, and also to the high prices of fuel and wages, engine drivers receiving £4 per week, and firemen £3, while the cost of fuel is 18s. per cord for hardwood logs 6 feet in length.



View of Alternators.

Previous to the erection of the central station, the local gas company possessed a monopoly of the town lighting, and gas was sold at the highly remunerative rate of 15s. per 1,000 cubic feet, consequently the advent of a cheaper illuminant was hailed with satisfaction.

After considerable delay a local company was formed, and the services of Mr. J. O. Callender, consulting electrical engineer, of Sydney, were secured, and tenders called upon his plans and specifications. Messrs. Crompton & Co., Ltd., of Chelmsford, secured the contract for the complete generating plant and mains.



Boilers and Wood Fuel.

The station buildings are constructed entirely of wood, and roofed with galvanised corrugated iron, and though scarcely artistic, are substantial, and serve their purpose admirably.

The boilers were constructed in the colony, and are of the type known as compound Cornish. They are 21 feet in length, and 6 feet 6 inches in diameter, with a single furnace, and the latter 12 feet of the boiler is fitted with 48 tubes, 3½ inches diameter. A Galloway tube is fitted vertically behind the furnace bridge and in front of the tube plate, ensuring complete circulation. In practice this type of boiler is very satisfactory, being economical in maintenance, and very quick steaming. A railway siding runs through the boiler house, enabling the heavy logs of fuel to be fed into the furnaces direct from the truck. Some idea of the size of these logs may be gathered from the illustration of the boiler house. The boilers are constructed of mild steel, for a working pressure of 125 lbs. per square inch.

The boiler feeding arrangements consist of a large duplex Pearn steam pump, capable of supplying four similar boilers, and in addition each boiler is provided with a Korting's injector. The feed pipes are in duplicate, and so arranged that either pump or injectors can supply from the town mains or from a large 5,000-gallon tank outside the boiler house.

The feed water is heated to nearly boiling point in a vertical tube type heater, by the exhaust steam from the engines, on its way to the atmosphere.

The main steam piping is of wrought-iron, arranged in ring form, with valves to isolate any faulty section, should such occur.

The engines, of which two are already installed, were built by Messrs. Browett and Lindley, of Patricroft, Manchester, and are direct coupled to two Crompton-Brunton alternators, by a flexible coupling. They are double acting, and of the compound, vertical, enclosed type, running at 450 revolutions per minute. Each engine is fitted with one of Holden and Brookes's patent steam separators, securing a supply of thoroughly dry steam.

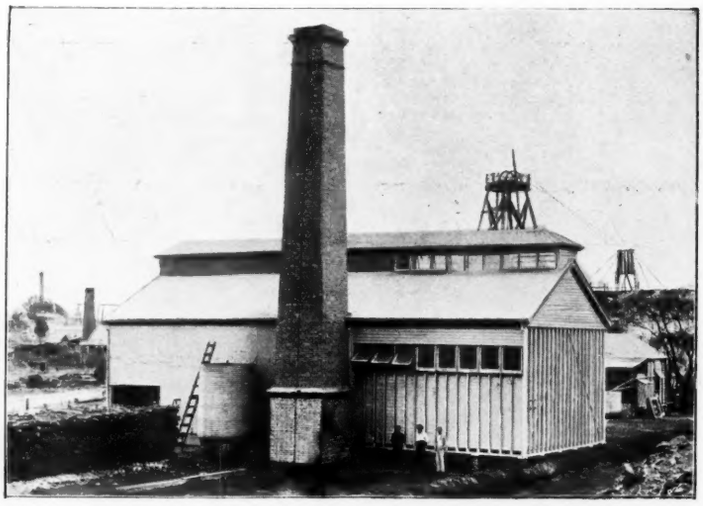
Both engines are fitted with forced lubrication, a small oil pump being worked by an eccentric from the crankshaft. The oil is forced from the reservoir in the crank chamber, up through perforations in the crankshaft and connecting rods, which are hollow.

Excellent governing is obtained by an "Acme" governor of the throttle type, and the admission of steam to the cylinders is regulated by a piston valve working between both cylinders.

The alternators are constructed for an output of 18·5

amperes at 2,200 volts. Each alternator has its exciter direct coupled on the main shaft.

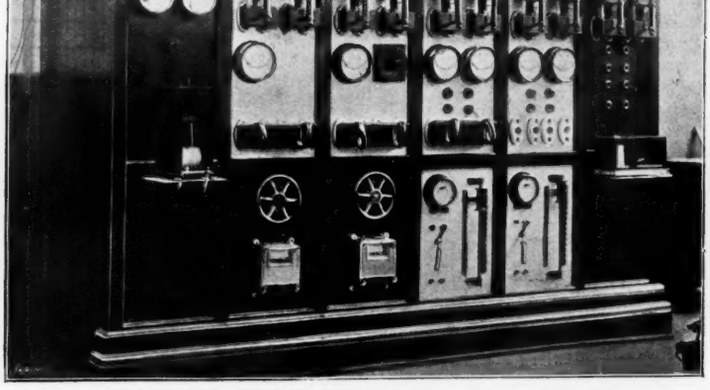
The switchboard is of the panel type, and constructed of white polished marble. A separate panel is provided for each alternator and one for each feeder. The alternator panel contains a double-pole switch and cut-outs, also an electro-static voltmeter, amperemeter, and synchronising plug switch. The lower part of this panel contains the exciter, regulating resistance, switch, and ammeter. The feeder panel contains high tension switch and cut-outs, also ammeter, and on the lower part are fixed the feeder regulators and Hookham's patent high tension wattmeters, recording the total output of the station. The feeder regulators consist of a choking coil with laminated core, in series with the feeder main.



Exterior View of Generating Station.

The high tension switches are of the plug type, and all contacts fit into porcelain tubes, which project well through to the back of the switchboard.

The right-hand end panel carries the synchronising gear, and also a Richards's recording high tension amperemeter reading to 50 amperes. The left-hand end panel carries two low tension voltmeters for reading the feeding centre voltage on both sides of the low tension system, and also a Richards's recording voltmeter on the Cardew principle. All the switchboard instruments and fittings are of Messrs. Crompton's well-known type, and the board, as a whole, is most simple and efficient.



Switchboard.

The whole of the cables supplied are of Messrs. Callender's make, and consist of lead-covered and steel-armoured concentric cables, laid 12 inches below the surface of the foot-paths. From the station two high tension concentric feeders run to two feeding centres, distant respectively 1,000 yards and 1,760 yards. At each of these points an underground brick chamber is built, which contains two 20-kw. Crompton-Brunton transformers, and two low tension triple-pole switches in cast-iron cases. From these sub-stations a low tension three-wire distributing system is laid through the principal streets of the town. To avoid having any joints inside the sub-station, a special jointing box of cast-iron is placed outside, in which the armoured cable ends, and vulcanised rubber cables are carried thence into the chamber through a 3-inch cast-iron pipe; a similar arrangement is made for the low tension distributing mains. From each feeding centre a three-cored lead-covered and steel-armoured cable containing three 7/22 cables is laid back to the station, and enable the voltage on both sides of the system to be recorded. These transformers are all constructed with a primary winding for 2,000 volts, and the secondary is wound for a three-wire distribution, giving 102 volts between neutral and outers. The service boxes are of the usual type, and provide for one, two, or three services. From these boxes the armoured cables, of the same type as the mains, run into the consumers' premises, and terminate in Reid's patent cast-iron fuse boxes.

Messrs. Chamberlain & Hookham's meters are used throughout, and supplied free of rental to consumers, the charge for current being 1s. per unit net.

The testing instruments provided for the station consist of a Silvertown portable set reading to 50 megohms, and also Weston's standard alternating volt and ampere meters.

In view of the rapid extension of the lighting, tenders have been called for an additional 80-kw. direct coupled set, and a new transformer sub-station is being built to contain two 15-kw. transformers.

The supply, so far, has been thoroughly satisfactory, and Mr. Callender may be congratulated in having done so much toward raising the standard of electricity supply and house wiring in these colonies.

The work was carried out by the Sydney branch of Messrs. Crompton & Co., Limited, under the superintendence of their manager in Australasia, Mr. E. J. Erskine, and Mr. F. B. Hobler, formerly of the electric department of the Rockhampton Gas and Electric Supply Company, holds the position of resident electrical engineer. In conclusion, it may be interesting to note that the works' cost per unit

has fallen 50 per cent. during the first 12 months of supply, and still better results are anticipated as the demand for light increases.

A NEW USE FOR ALUMINIUM.

Though the people interested either in the production or the sale of aluminium are always ready to assert that there is a steady and growing consumption of the metal in the arts, and that the industry is rapidly extending, they will probably hail with considerable satisfaction a new use for aluminium which would appear to promise a considerable demand for the metal in quite a new direction, namely, as a fuel and reducing agent in metallurgy.

Dr. Goldschmidt read a paper upon this subject recently before the annual meeting of the German Society of Electro-Chemists at Frankfort,* and on Monday evening, June 20th, Mr. Claude Vautin described this new use of aluminium to the members of the London Section of the Society of Chemical Industry, while Dr. Goldschmidt himself attended to conduct the experiments. We give below a condensed report of Mr. Vautin's paper.

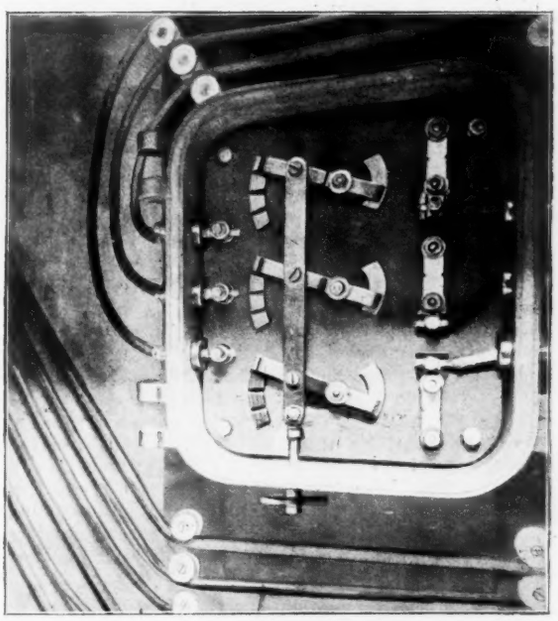
The discovery of the reducing powers of granulated aluminium was made by Mr. Claude Vautin some years ago when experimenting with this metal at high temperatures. The earlier experiments were conducted with the sulphides of other metals, and it was found that with the aid of external heat, all the metallic sulphides with the exception of those of magnesium and of the alkali metals could be reduced in this way. The heat of formation of Al_2O_3 is, however, 360,000 thermal units, and exceeds that of Al_2S_3 by 237,000 units, and further experiments proved that the reducing action of granulated aluminium was even more striking when working with the oxides of other metals, and that temperatures could be obtained in this way approaching those of the electric furnace.

Dr. Goldschmidt was interested in the subject by a perusal of the account of Mr. Vautin's work, and he was thus led to continue the investigations in Germany. He found that in the case of the oxides the external heating could be dispensed with; as if the action were once started in any part of the mass, it propagated itself with more or less violence and rapidity according to the oxide used. It is this discovery that has made the reaction one of industrial importance, and has led to its use in Germany for the production of ferro-chromium upon a commercial scale for the use of steel makers. The *modus operandi* is as follows: The powdered aluminium is intimately mixed with the finely crushed and dried oxide of the metal to be reduced. This is placed in an ordinary crucible, and the reaction is started by means of a special cartridge containing barium peroxide and a magnesium ribbon. When a light is applied to this cartridge, the heat generated is sufficient to start the reducing action of the aluminium upon the metallic oxide at the point where the cartridge is resting on the mixture. It then proceeds downwards through the mass, and can be kept up as long as desired by feeding the mixture of powdered aluminium and oxide into the crucible.

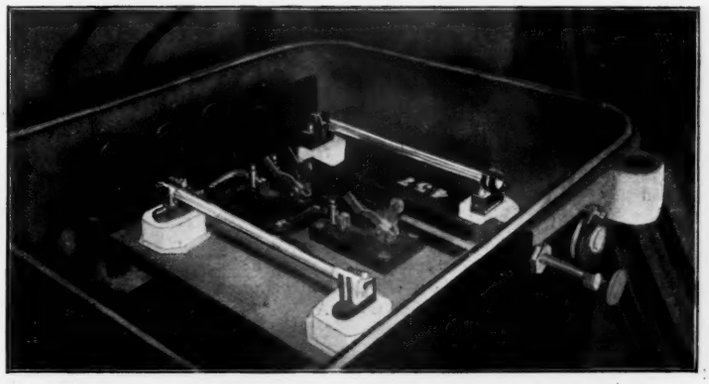
In the case of lead oxides the reaction takes place with almost explosive violence, and it is necessary to add inert substances to the mixture in order to moderate its intensity.

The temperature attained is estimated by Dr. Goldschmidt to be 3,000° C. The slag of alumina produced by the oxidation of the aluminium is so fluid that the reduced metal sinks without difficulty to the bottom of the vessel in which the reduction has been carried out. On cooling this slag crystallises as corrundum, and on account of its remarkable hardness, has considerable commercial value as an abrasive material. It is claimed that by this process aluminium can be used:—

1. To produce high temperatures in any spot without the aid of any external heat or electric current.
2. To reduce refractory oxides such as those of chromium and manganese at a low cost of treatment.
3. To produce metals absolutely free from carbon, and containing only the impurities of the oxide and aluminium used.



Charters Towers.—Sub-Station Switches.



Charters Towers.—Transformers.

The experiments which were carried out by Dr. Goldschmidt after the reading of the paper certainly fulfilled all the claims made for aluminium as a heating agent. The lecture room of the Chemical Society in Burlington House is hardly adapted for such a display of pyrotechnics as the worthy doctor had prepared for his audience, and when he had raised the temperature of the room and of his auditors to about 110° F., and had nearly choked the latter with metallurgical fumes from white hot mixtures which were scattering particles of molten matter freely about the place, it was decided that both the comfort of the audience and the safety of the building demanded an adjournment to the open area inside the gates of Burlington House. The further experiments were therefore carried out

* *Zeits. fur Elektrochemie*, 1898, Vol. iv., p. 481.

in the open air much to the relief of the chairman of the meeting, and not least—of the custodian of the premises of the Chemical Society.

REVIEWS.

Submarine Telegraphs: their History, Construction, and Working. By Charles Bright, F.R.S.E. London: Crosby Lockwood & Son, Stationers' Hall Court.

This book, which is stated to be founded in part on Wünschendorff's "Traité de Telegraphie Sous-Marine," and to be compiled from authoritative and exclusive sources, will not, we fear, make the reputation of the author. We can unhesitatingly say that the paper and printing are excellent, but the excellency of the work begins and ends there. There are, doubtless, good points in the compilation, and to a superficial observer it might appear to be a book of considerable merit; unfortunately, however, it will not stand the test of even a moderate examination. The work teems with blunders of the most marked description, and indicates that the writer's knowledge of his subject is not perfect. These mistakes are not mere slips or printers' errors (though there are plenty of the latter) but downright blunders; what, for instance, are we to think of the following:—"As a metallic circuit for telephonic purposes is absolutely essential on account of *extra* (the italics are our own) induction when using the earth as a return, the distance between which telephonic working is possible is still further limited. This looping, however, has the effect of something like *doubling* the K R by, roughly speaking, doubling the length of wire in circuit"; a more egregious error from a man professing to be a telegraph engineer it is almost impossible to conceive. We are told in a note that if the diameter of the conductor of an insulated wire is doubled, the thickness of the dielectric remaining unaltered, then the capacity is exactly doubled, an absolutely untrue statement. On another page, "the difference between the conductor diameter and the outside diameter gives the thickness of dielectric. The electrostatic capacity of Willoughby Smith's improved G.P. is about *one-fifth* of ordinary gutta." What are we to think of the appalling misconception of hydro-dynamics shown by the following:—"The pressure test as applied to core after manufacture, does not, of course, quite represent that which takes place when the core is afterwards submerged, as in the latter case it is ensheathed in an iron armour. Moreover, strictly speaking, uniform pressure round a core does not exactly represent what is afterwards experienced on submergence at the bottom of the sea, where it is a question of weight of a certain column of water resting on the cable, which is itself resting on the bottom. If it were a matter of uniform pressure the effect would be the same, no matter what the depth to which the cable is lowered below the surface of a given column of water." Passing from hydro-dynamics to mechanics, what are we to think of this?—"Obviously there are two points which govern the length of lay obtained, of which one is 'the distance of the bobbins on their universal carriage from the lay or closing plate.'" Again (speaking of cable machines), "the axis of each bobbin is so controlled that during the revolution of the carriage it remains perpendicular to the plane of the earth and to one another." This is multi-dimensional space with a vengeance; doubtless, Mr. Bright's definition of an eclipse would be "when the sun and moon get between one another." We are actually told that "hemp yarns are tested for torsion though they are far less homogeneous than iron." We may perhaps be accused of picking out a few isolated cases of mistakes which might naturally be expected in a book of the size of that in question; we could, however, multiply them almost indefinitely, and the mistakes are obviously not mere slips, which are pardonable, but must be attributed to some other cause. In many cases the author seems either incapable of expressing what he actually means, or else he imagines that a confused jumble of words forming sentences full of inaccuracies, but which at the same time will give the reader an idea of what the writer intends to express, is quite good enough for the purpose of the book. For instance, we are told (page 87) that by means of a brake the speed of a drum with a given strain was checked *or accelerated*; we can hardly believe that the author really means this (we are sorry if he does), but the looseness of phraseology is most deplorable.

On page 223 we have the statement that the resistance of one foot of pure (soft) copper wire weighing one grain at temperature of 0° C. is ·2064 of the *legal* ohm; surely Mr. Bright cannot be so oblivious to the standard as this seems to show. The omission of the factor 100 in the formula for the conductivity of copper wire is a rather bad error; a similar error occurs on page 241 when the writer speaks of "percentage" extra length of wire required, but the factor 100 is left out.

On page 227 we have the statement that for a given total weight of copper the resistance of stranded and of a solid wire should be the same; as a matter of fact this is not the case, due doubtless, to the fact that the contact between the centre and the surrounding wires is never good.

As regards the historical and descriptive matter, which forms the greater portion of the book, a more favourable opinion can be expressed. Mr. Bright has certainly got together a mass of information which, to a limited number of readers, will prove of considerable interest, and as a record of what has been done it is valuable; at the same time, however, no matter how well and completely such matter may have been put together, one is tempted to say what is the good of it all. The temptation to bring out a book of the kind is doubtless very great, but we are afraid that the author will find that he has taken an immense deal of trouble for very little, and that the volume, imposing as it appears, will fall somewhat flat; the inaccuracy of the technical information renders it misleading as a scientific work.

Essai sur la Theorie des Machines Electriques a Influence. Par V. Schaffers, Professeur au College de la Compagnie de Jésus à Louvain. Paris: Gauthier-Villars & Fils. Bruxelles: Polleunis & Ceuterick.

This little work claims merely to extend the theories of the influence machine, which have been elaborated principally by Holtz and Poggendorff; but Prof. Schaffers has added a good deal to the work of these early authorities by independent investigations of his own. The theory of the influence machine has been the subject of numerous memoirs, and though in its main principles it is simple, there are many secondary actions which considerably modify its working, and many points even at the present date are still waiting for explanation. All that has hitherto been done has been set forth in admirable form by Prof. Schaffers, and those who wish to get a grasp of the operation of the influence machine in all its leading forms, could not do better than begin by studying his little treatise. The popular impression in this country appears to be that there is only one influence machine, namely, the Wimshurst. Some few may have heard of the Voss and the Holtz machines. But still fewer seem to be aware that what is known as the Holtz machine in this country, is only one of about half-a-dozen different machines invented by this same physicist. This fact, at least appeared to be unknown to an otherwise well-informed physicist who recently took part in a discussion in these pages. As a result of this ignorance of the history of influence machines, some of these have enjoyed the good fortune of having been several times re-invented. As Schaffers points out, the Belli machine has been three times independently invented, by Belli, by Kelvin, and quite recently by Elster and Geitel, and the Wimshurst machine twice, namely, by Holtz and by Wimshurst. Prof. Schaffers's experiments on the relative output of machines of different types are exceedingly interesting. Such results are, of course, much influenced by leakage, and consequently depend greatly on the careful construction of the machine. Schaffers's experiments show that for ready self-excitement and output the Voss machine is superior to the Wimshurst, although it is rather more liable to reversal than the latter machine. Schaffers has shown by experiment that when the collecting combs of the Wimshurst machine are displaced relatively to each other, a much better result is obtained. Musaeus, as Schaffers points out, was the first to discover this, and the improvement has also been introduced by Wimshurst in his larger machines. The influence

machine has been shown to be admirably adapted for the production of Röntgen rays and for laboratory experiments where currents of high tension and small quantity are required. A study of Schaffers's excellent work will well repay those who seek to understand and improve this machine. We notice at page 44 a printer's error in a date (1857 for 1867); but on the whole the work appears to be very accurate, and the original memoirs on this subject in all languages have evidently been mastered and utilised.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 272.)

Limerick.—At the meeting of the Limerick Corporation on Thursday, 11th inst., an application was made by the Limerick Electric Tramways Company for provisional powers to promote electric tramways in the city. Mr. H. D. Conner, B.L., and Mr. H. J. Fuller, C.E., Dublin, appeared in support of the application. Mr. Conner stated that the company was composed of wealthy Dublin gentlemen. They proposed to construct a complete system of tramways in the city to connect the railway with the docks, and run through the principal thoroughfares both for passenger and goods traffic. The estimated outlay would be about £70,000, most of which would be spent locally, and thus promote the industrial well being. It was intended to have a 3 feet 6 inches gauge, and the current would be supplied from overhead wires. Mr. Fuller gave engineering evidence of the scheme, which had been approved of by the engineering inspector of the Board of Works, Mr. Price, C.E., except in two streets—High Street and Mungret Street—which he considered too narrow for tramways. He approved of the overhead wire system. The total capital of the company would be about £75,000, which he guaranteed would be forthcoming. The promoters of his company were prepared to offer the Corporation a certain sum for the ground necessary for the lines, but they had not yet considered what that sum would be. A memorial was presented in opposition to the scheme by a firm of Dublin solicitors, who said that at the proper time they would be prepared to submit an advantageous scheme for consideration. Mr. Conner asked that a resolution be passed formally approving of the scheme. The Council declined to do this on the ground that they had no information of its details. It was decided, while approving of a general scheme of tramways for the city and district, to postpone the present application to a future date, of which notice would be given to the promoters. It is understood that applications for powers will also be received from other companies.

Walsall.—The Town Council has resolved that the Council should oppose the proposed application to Parliament of the British Electric Traction Company, Limited, for a Bill to confirm a lease of the tramways of the South Staffordshire Tramways Company.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1898 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Caimanera-Santiago de Cuba	June 10th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Accra-Kotonou	Aug. 8th, 1898 ...	...
Hong Kong-Manila	May 3rd, 1898 ...	...
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Bolama-Bissao	July 21st, 1898 ...	...
Cape Town-Mossamedes ...	Aug. 2nd, 1898 ...	August 13th, 1898
Olehleh-Medan	Aug. 9th, 1898 ...	August 15th, 1898
Landlines.		
Trans-Continental line beyond Mszol	March 12th, 1898 ...	...
Cartagena-Barranquilla ...	July 4th, 1898 ...	...
Siberian lines, Tschita-Stretenskaia	August 8th, 1898 ...	August 10th, 1898
Moulmein-Bangkok	August 16th, 1898 ...	August 16th, 1898

African and All-British Cables.—In the course of a recent lecture at Cape Town, Sir James Sivewright, formerly Commissioner of Public Works in the Colonial Government, drew attention, says the *Times*, to the important questions of cable communications in which South Africa is pre-eminently interested. After referring very confidently to the early completion of an all-British overland telegraph from end to end of Africa, Sir J. Sivewright explained the bearings of the African cable system on the larger question of telegraphic intercommunication between the different parts of the British Empire. At the present time, he said, there were two cables to the Cape. The one which came down the west coast touched partly at British, French, and Portuguese territory. That cable was continued down to Cape Town. They would all see the importance of an all-British cable. At the present time there were five modes of communication between England and the East. The first by way of Russia, the second through Germany, Austria, Turkey, and the Persian Gulf to India, the third through France, Italy, and on to the Red Sea, the fourth from London to Gibraltar, through the Mediterranean, and on to India, and there was the fifth route by Lisbon to South Africa, &c. One great advantage, of course, in having these various lines of communication was that they secured alternative routes. In telegraphy it never did to put all their eggs into one basket, as the agents they had to deal with were so fickle. But what they were striving for was to make the lines of communication safe and reliable; that was to say, that if a person handed in a message at one place, he ought to have a certainty that it would reach its destination. The Pacific Ocean had never yet been bridged by cable. Two rival schemes were in existence at the present time in order to get an all-British cable connecting England with her Eastern possessions, and touching only on British territory. The cable should be as far as possible on British soil, or lying at the bottom of the sea where England might be trusted to look after it. One route was from England to Gibraltar, then on to Sierra Leone, Ascension, St. Helena, on to the Cape, and overland to Durban, and thence to Mauritius, Koko's Island, and Western Australia, with the branch which was already in existence between Mauritius and Ceylon. This line was advocated in certain influential quarters, and the rival to it was the route from London to Newfoundland, through the Canadian dominions to San Francisco, across the Pacific, and down to Australia. These were the two rival routes which were being contended for at the present moment.

French Atlantic Cable.—The daily press says that the second French Atlantic cable was completed on Wednesday morning. It is reported to be the longest cable that has ever been laid, and the thickest core that has ever been manufactured. The wire was joined through to White House, Washington, in the afternoon, when telegraphic courtesies were exchanged between Presidents Faure and McKinley.

The Telephone Question.—"A Telegram" writes to the *Times* as follows:—"The bold words used by the Select Committee on Telephones, at page 13 of their report, ought to set at rest all fears for the future of the telephone in this country. As you are aware, the Committee are not only strongly of opinion that general, immediate, and effective competition, by either the Post Office or the local authority, is necessary, but they 'consider that a really efficient Post Office service affords the best means for securing such competition.' Although the case could not be more forcibly stated, yet the public should still be on its guard, inasmuch as, while the hand in the report is the hand of the Secretary of the Treasury (to extinct boards of which department the regrettable failures to popularise the telephone in the past must be ascribed), its voice is not necessarily that of the Chancellor of the Exchequer, yet all depends on him. With that high functionary it rests to mar or reap the harvest of the Committee's valuable labours. The leaders of commerce should, therefore, lose no time in procuring from the Government a binding declaration of intention on this vital question. Its solution is a free hand to the Post Office and a liberal provision of money. Procrastination at Whitehall and timidity of purpose have well-nigh stifled the telephone in the United Kingdom; vigour and cash—there and at St. Martin's-le-Grand—may yet redress the follies of the past. A Cabinet Minister one told me that in his experience 30 years were needed for any great public reform. In my small way I have watched and tried to help this particular reform for 27 years; so that, at last, there seems to be a fair prospect of a truly national question being prosperously settled within the named limit of time."

The Hull Chamber of Commerce has received a reply from the Postmaster-General, in which it was stated that the development of the trunk wire system of the country continued to engage his careful attention. Since the memorial of January last the Lords Commissioners of the Treasury had sanctioned the erection of a large number of additional circuits between important centres, and a Bill for raising a further sum of £1,000,000 as telephone capital was now under the consideration of Parliament. As soon as the requisite funds were provided the works would be proceeded with as rapidly as possible.

Telegraphic Communication with the West Indies.—The end of the Spanish-American war has already improved matters in the West Indies telegraphically, and it is interesting to look back for a moment to see how cable communication was affected during the conflict, and what its present state is. The United States Government now allow messages in secret language to pass between the States and the West Indies, with the exception of Porto Rico and Cuba, to which islands telegrams must be written in plain language. Telegraphs played a great part in the recent war, and the importance of having direct and speedy cable communication was amply demonstrated. Throughout the whole of the war, the only telegraph route to the West Indies which was not interrupted, was that "*via* Bermuda," and as this was only opened in January last, it must of necessity have been a great boon to the West India merchants, as well as every nation having any business interests in the West Indies, for otherwise, these islands would have been telegraphically completely cut off from the world. It is a matter for congratulation that the British "*via* Bermuda" cable route—it touches only British territory—was not interrupted. It is marvellous what security is enjoyed by anything that is privileged to call itself "British."

The Army Manœuvres and Military Telegraphy.—The *Daily Chronicle* outlines the arrangements which have been made with respect to the employment of telegraphy in connection with the army manœuvres as follow:—There will be provided a field telegraph for each army corps; neutral semi-permanent lines connecting each army corps headquarters of the several camping rayons with their respective divisional camps; neutral semi-permanent lines connecting the director and umpire-in-chief's camp, and the headquarters of the several camping rayons into one another. The opposing forces are not to damage any telegraph lines or offices within the manœuvre area; but under certain circumstances a field line may be put out of action. The neutral lines will only be available to the two army corps for those purposes for which the telegraph lines between an army corps facing the enemy and its own base of operations would be used. They are not to be tapped or interfered with, nor are they to be used for the purpose of deceiving the enemy or for giving information in regard to either side which should be withheld from the enemy. Field post offices will be established by the Post Office Corps at the headquarters of each army corps, infantry division, and cavalry brigade.

The Pacific Cable.—In the House of Commons at the end of last week Mr. Provand asked the Secretary of State for the Colonies whether he could inform the House of the present position of the negotiations relating to the proposed Pacific submarine telegraph cable from British Columbia to the Australian colonies.—Mr. Chamberlain: We have no proposals from Canada or from South Australia, Western Australia, and New Zealand. The premiers of the remaining four Australasian colonies have joined in a resolution that their colonies will favourably consider the proposal for a Pacific cable provided that Canada and the United Kingdom will each contribute one-third of the cost. Until we have formal and definite proposals from all the Governments concerned, Her Majesty's Government cannot proceed further in the matter.

Mr. Roland Belfort puts the case for the Pacific cable very convincingly in a letter to the *Times*. He says:—"The *Times* is constantly emphasising the fact that the problem of the protection of British interests in the Far East, menaced by astute, unscrupulous rivals, is daily becoming more urgent. Will you allow me to point out that an important factor in this problem is the projected all-British Pacific cable, the immediate establishment of which has become imperative? Both Imperial and colonial interests demand it. Canada and Australasia are willing to participate with Britain in its cost. It would liberate colonial cablers from the present crushing cable "corner." A cablegram from Vancouver to Melbourne has to tour the world, costs over 6s. per word, and is often subject to disastrous and exasperating delays. By the direct Pacific cable it would cost 2s. per word, and arrive within the hour. Until this alternative cable is laid, our Australian colonists will frequently be compelled to depend on the shaky Siberian land-lines for telegraphic communication with the mother country. Those lines are controlled by Russia. Naval and military experts assert that our foreign-controlled cables would certainly be cut by our enemies during any crisis. This might imperil the very existence of outlying portions of the Empire. Britain thus needs a strategic cable system free from foreign control. Commerce needs a system free from the deadly grasps of the monopolists. If the Pacific route existed, the cabling public would save nearly £225,000 per annum. In eight years this sum would pay for the new cable. The project is perfectly practicable from the electrical, engineering, and financial standpoints. The control of Pacific cable communication should by right devolve on the British—the pioneers and principal constructors of the world's submarine cable system. To allow another nation to forestall us by executing this great work would constitute a most humiliating abdication of our recognised position as lords of the ocean depths. Finally, by a mutual effort, Britain, Canada, and Australia can establish this communication without the slightest cost to their taxpayers. Under these circumstances would not the Imperial Government be quite justified in taking the initiative in this project, which is generally considered to be ripe for execution? Recent official declarations on the part of Australasian Premiers prove beyond doubt that such action would meet with a cordial response from the colonies concerned."

A Dalziel despatch dated Vancouver, B.C., August 15th, says that "Mail advices from New Zealand report that the Premier, Mr. Richard Seddon, is in favour of a trans-Pacific cable between British North America and the colony, and is prepared to offer a large subsidy if Canada will join in the project. He says likewise that England will help materially."

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—August 27th. The Committee of the Central Conservative Club invite specifications and tenders for the installation of the electric light in the club buildings. Tenderers will have to prepare a complete specification. Tenders to Mr. John Moss, secretary.

Ashton-under-Lyne.—August 29th. The Electricity Committee want offers from persons desirous of entering into arrangements for the wiring of premises within the borough on any system of deferred payment. Particulars from Messrs. Lacey, Clirehugh and Sillar. See our "Official Notices" August 5th for particulars.

Bangor.—September 10th. The Corporation is inviting tenders for the supply and erection of two water-tube boilers, economisers, steam and other pipes, pumps, &c., two 60-kw. dynamos, balancer, boosters, 5-ton travelling crane, switchboard, accumulators, mains, &c. Consulting engineer, Mr. F. H. Medhurst. See our "Official Notices" August 12th, for particulars.

Belgium.—October 27th. The municipal authorities of Ghent are inviting tenders until October 27th for an installation of electric lighting in the new Flemish theatre in that town. Tenders to L'Hotel de Ville, Ghent, Belgium, from whence particulars may be obtained.

Buxton.—September 5th. The District Council wants tenders for the supply of water-tube boilers, mechanical stokers, engines, dynamos, pumps, &c., battery, switchboard, exhaust, feed, and other pipes for the establishment of electricity works. Consulting engineer, Prof. A. B. W. Kennedy. See our "Official Notices" August 12th.

Halifax.—August 24th. The Corporation Tramway Committee is inviting tenders for excavating and forming about 5 miles of tramway track within the borough. Particulars on application to Mr. Edward R. S. Escott, C.E., borough engineer, Town Hall, Halifax.

Hull.—August 25th. The Electric Lighting Committee want tenders for the supply and erection of a 750-I.H.P. Willans or Belliss type engine, a 460-kw. high tension continuous current dynamo, and two 30-feet × 8 feet Lancashire boilers, for the electric light works. City electrical engineer, Mr. A. S. Barnard. See our "Official Notices" July 29th.

Kingston-upon-Hull.—September 30th. The Corporation want tenders for the supply of 45 electric motor cars, 20 trailers, 2 sprinkler cars, and 2 traversing platforms. Specifications from Mr. White, city engineer. See our "Official Notices" this week.

North Staffordshire.—September 5th. The British Electric Traction Company is inviting tenders for the provision of materials and construction of the track and permanent way of about 13 miles of tramways (in sections) in the Potteries district of North Staffordshire, for the British Electric Traction Company, Limited. Particulars obtained on payment of a deposit of £3 3s. at the Company's Permanent-way Engineer's Office, Donington House, Norfolk Street, Strand, W.C.

Patras.—The following notice appears in the *Times*:—"On Sunday, the 16-28 August of this year, in the morning, from 9-11 o'clock, will be given out in submission, in the Town Hall of Patras, in presence of the Municipal Council, and in public session, the concession of the lighting of Patras and its suburbs. In case the lighting will be executed by gas, the period of the concession will be of 35 years, or in case the lighting will be executed by electric light or another light, the duration of the concession will be left to the discretion of the competitor, according to the conditions of our advice No. 2,222 of this year and according to the register of February 7th, 1898, modified by the above-mentioned advice No. 2,222. Offers are to be submitted under sealed cover. A copy of the above-named documents, in Greek or in French, will be delivered to every interested firm which will ask it from us or from the president of the municipality.

"Patras, July 12th, 1898.

"The Mayor of Patras,
"Thanos Canacaris."

Rochdale.—September 6th. The Corporation wants tenders for the supply of boilers, economisers, condensing plant, feed pumps, steam and exhaust piping, travelling crane, switchboard, accumulators, and cables for the electricity installation which is to be put down. Consulting engineers, Messrs. Lacey, Clirehugh and Sillar. See "Official Notices" August 5th for particulars of the various sections.

Roumania.—September 22nd. Tenders are being invited until September 22nd by the municipal authorities of Braila, Roumania, for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, La Mairie de Braila, Roumania.

Spain.—Tenders are being invited until the 22nd inst. by the Spanish Post and Telegraph authorities in Madrid for the supply of 22,000 rolled zinc cylinders required in connection with the telegraph service. Particulars may be obtained from, and tenders to be sent to, La Direccion Général des Postes y Telegrafos, Madrid.

Wimbledon.—August 29th. The District Council invites tenders for the supply, delivery, and erection of pipe work. Mr. A. H. Preece, consulting engineer. See our "Official Notices" August 5th.

CLOSED.

Aberdeen.—The Gas and Electric Lighting Committee has decided to accept the offer of Messrs. Crompton & Co., Limited, to supply patent insulators for the prevention of waste in the electric culverts at a cost of £1,186. The estimated cost of fitting up the culverts is £950, making a total of £2,136. The work will be commenced in about three weeks.

Austria.—The municipal authorities of Prague have just placed the contract for the supply of the cables required in connection with the central electric lighting station in the town with Messrs. Felten & Guilleaume, of Mulheim.

Belgium.—Tenders were lately invited by the municipal authorities of Stavelot for the concession for the electric lighting of the town during a period of 30 years. Only one offer was received—from the Société Electricité et Hydraulique, of Charleroi—who offered to undertake the work on the following terms:—7 centimes per hectowatt hour for private lighting; 5½ centimes per hectowatt hour for power purposes; and 7 centimes (less 7 per cent.) per hectowatt hour for the electric lighting of the municipal buildings.

Bury.—The Council has adopted recommendations of the Electric Lighting Committee to the effect that the following tenders be accepted, subject to the approval of the Local Government Board, viz., Messrs. Davey Brothers, Sheffield, for the boilers, &c.; the Callender Cable and Construction Company, for the mains, &c.; and Messrs. Fowler & Co., Leeds, for plant, &c. The tenders, with the cost of the engineer, clerk of the works, &c., amounted to £19,439 15s. exclusive of the cost of buildings, which is estimated at £2,500, making a total of £21,939 15s. The loan for which permission has been applied for is £20,000, making, with the sum of £2,500 in the hands of the Gas Company, £22,500, which will leave £560 for contingencies.

Halifax.—The first car extension contract for the Corporation tramways, has been placed with the British Thomson-Houston Company, Limited.

St. Helens.—As the result of tenders received recently, this company has placed an order with the British Thomson-Houston Company, Limited, for 16 complete motor-cars (the first equipment contemplated). Eight of these will be large bogie cars, with top seats, to carry 68 passengers, and eight will be single truck cars, with top seats, and adapted to carry 53 passengers.

Yarmouth.—At the meeting of the Great Yarmouth Town Council on Tuesday last week, the tender of Messrs. Willans to supply a 150-kw. alternator for £1,989 13s. was accepted.

NOTES.

An Electrical Method for Production of Finely-divided Metals.—An interesting note upon the use of the electric arc for the production of metals in the finely-divided state was read by Dr. Bredig, at the recent annual gathering of the German Electro-Chemical Society, at Leipzig. We give below a brief summary of the report of this paper appearing in the *Zeits. f. Elektrochem.* 4, p. 514. Dr. Bredig had been investigating the phenomena attending the discharge of high tension alternating currents under the surface of various liquids. He observed that when metal poles of small diameter were used, a cloud of finely-divided solid matter was formed around the arc, and on further investigation this proved to be of the same chemical composition as the metal used for the poles. The state of sub-division was so fine that the water or other liquid appeared as though some colouring matter were in solution, and several days were requisite to obtain deposition of the metal upon the bottom of the vessel. Zinc, lead, silver, gold, and platinum were all obtained in a state of extreme sub-division in this way. In the case of zinc the author states that two Russian chemists had already published a note upon the phenomenon. The results obtained are attributed by Dr. Bredig to the condensation by the water of the metallic vapour, which always surrounds the electric arc, when metallic poles are used. The method is of laboratory service for the production of finely-divided platinum, capable of catalytic action, direct from platinum wire.

Bristol Electrical Works.—The Institute of Marine Engineers (Bristol Channel centre) visited Bristol on Saturday for the purpose of inspecting the electric tramways and power station, also the Corporation electricity works. Mr. Wood, the engineer of the Electric Tramway Company, and Mr. Challenger, the traffic manager, escorted the party over the tramway system, and Mr. Faraday Proctor acted as guide at the electricity works. After the inspection of other engineering works of interest, dinner was provided at the Royal Hotel, College Green, Prof. Elliott, D.Sc., being in the chair. This was followed by a paper by Mr. N. Appelbee, the Cardiff Corporation electrical engineer, on "Electric Lighting Stations," in which he described what, in his opinion, constituted a model station. The chairman contributed some notes on electric traction, which he said he had advocated for 20 years past. Cardiff trams, he added, were a disgrace, but Bristol trolley lines set a splendid example.

An Harmonic Analyser.—In the *Physical Review* (America) for July, Mr. T. N. Le Conte describes an harmonic analyser, working nearly on the principle employed by Mr. G. U. Yule in the instrument described some years ago before the Physical Society. It will be remembered that this depended on giving to the pointer of an Amsler's planimeter, a reciprocating motion about a point carried round the curve to be analysed. The mechanical construction of his apparatus was very simple compared with the preceding instrument of Henrici, mainly because the human hand was employed, and was found easily able, to perform a complicated geometrical operation. Mr. Le Conte has arranged a new instrument for performing the operation with less dependence on the human hand; and though of considerable complexity compared to Yule's, it is very much simpler and more easily made than Henrici's. A board carrying a polar planimeter is moved bodily along the curve to be analysed, while to the pointer is given independently the required reciprocating motion. The action is clearly susceptible of great accuracy within the limitations of rolling planimeters. The first eleven harmonics of a zig-zag straight line have been tabulated from calculation, and also measured with the instrument, and the errors are very small, in no case exceeding 1 per cent. We should imagine that periodic curves requiring harmonic analysis occur very rarely in practice, and that occasions for the use of such instruments are almost entirely educational. For this purpose the results can be obtained with little labour and great accuracy by directly measuring the ordinates of the curves. In the history of mechanical integrators this instrument of Le Conte's will be of interest. By a small modification of construction the instrument can be made into a curve tracer for combining any set of harmonics.

An Electrician as Novelist.—The *Strand Magazine* for the present month contains, among other good things, an illustrated article by Archer P. Crouch, entitled "Submarine Cable Laying." The account is felicitous, clear, and technically correct; moreover, Mr. Crouch has a style admirably suited to this kind of narrative. Such is the advantage of being a novelist as well as an electrician. At Oxford the author took his degree in science; he then turned his hand to submarine cable work, and his mind to the art of writing. He has published six books, of which five are novels, and one a discussion of social problems. Several articles from his pen have been contributed to such magazines as the *Nineteenth Century* and the *Cornhill*. Two of his novels have appeared this year; the first, "Senorita Montenar" (Smith, Elder & Co.) is a tale of the Chilian War of Independence in 1818; the second, "For the Rebel Cause" (Ward, Lock & Co.), is a romance-history of the more recent struggle between Balmaceda and the Chilian Congressionalists. They are "fighting" tales, both of them, with plenty of incident, and polite love-making. The incident is so stirringly told that at times the plot gets a little timid of it. But these things are merely matters of adjustment of the balance and looking to the connections; Mr. Crouch will doubtless grapple with them in his books to come. Such is the advantage of being an electrician as well as a novelist.

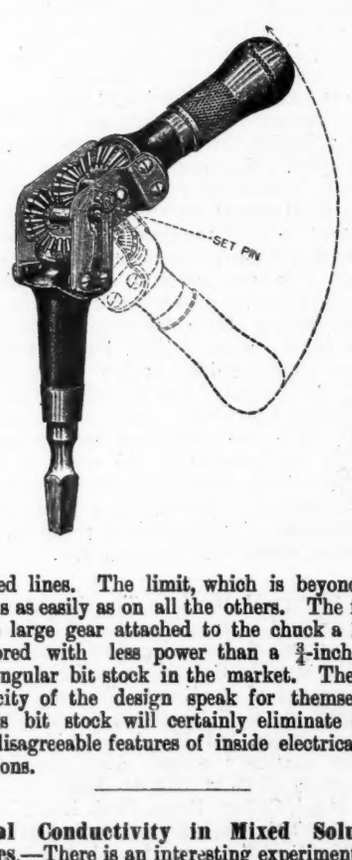
Explosions in Main Boxes.—Late on Thursday night last week an accumulation of gas in the electric light mains beneath Cumberland Terrace, Regent's Park, led to an explosion which blew the cover of a main box into the air. There was a failure in the arc lighting for a few minutes, and the private lighting was also affected for some time.

Further details of the Oldham explosion, to which we briefly referred last week, go to prove that the affair was more serious than we at first supposed. A leakage has since been discovered in the gas mains, and this was undoubtedly the cause of the accident, the gas having accumulated in the electric light culverts and become ignited by a spark when an arc lamp was switched off. The pavement was torn up for 40 or 50 yards and main box covers were flung to the other side of the street, which is in a busy part of the town. We understand that Mr. Newington, the chief electrical engineer, is having new cables laid in iron pipes. A number of people were severely shaken, but after treatment all were able to proceed to their homes.

Emmens, the Gold Maker.—Since this gentleman left off exploiting batteries, and transferred himself to the United States, whither many a better and many a worse have gone before him, he has, as our readers know, acquired a certain notoriety as a manufacturer of the royal metal out of the baser metals. We never knew that he was "a physicist of reputation," as the *Engineer* described him the other day; but then we do not suffer from shortness of the editorial memory as some of our contemporaries do. We have never known him as "an able controversialist," as the *Engineer* also describes him; but we are willing to admit that he is *smart* in the true American acceptance of this term. Let but a crumb fall from the laboratory table of a scientific man, and Emmens will catch it up and convert it into loaves. It seems that Emmens claims to transmute silver into gold by subjecting the former metal to continuous hammering, whilst at the same time he takes measures to prevent the temperature rising, for every 'prentice hand knows that a piece of metal placed upon an anvil and repeatedly tapped with a hammer will become so hot that anyone who tries to pick it up will quickly drop it. According to Emmens, this rough treatment results in the silver being, as it were, shaken out of one constitution into another, the resulting substance being argentaurum, from which gold can be reduced. Bearing in mind Sir William Crookes's views, as expressed in his presidential address to the Chemical Society in 1888, Emmens considered it would be a good thing to draw this chemist, and he succeeded in doing so. Sir William Crookes, following Emmens's directions, subjected a Mexican dollar to a hammering process, which lasted for 40 hours, and all the while the dollar was kept at a temperature considerably below the freezing point of water. The experiment was rather roughly performed, and a slight excess of gold was observed in the assay after the experiment was concluded. However, this slight excess was within the limits of error of the experiment, and in subsequent experiments, carried out much more carefully, this excess was not noticed, and the result was, in Sir William Crookes's own words, "an utter failure." Emmens is now going about claiming that these experiments support his theory. Since he is avowedly "a mammon-seeker," we cannot be surprised, as, indeed, the *Engineer* says, that he should make the most of every little advantage. But straight men will not think any the better of Emmens for the way in which he is using his private correspondence with Sir William Crookes, twisting the latter's statements in his own way in order to advertise his great syndicate. A SYNDICATE! We thought it would come to that after all. A certain number of men possessing money must be got together, and their money must be transferred into the pockets of the great alchemist. This is the usual preliminary step, and we have no doubt that the usual sequel will follow. If Emmens can produce gold in such a simple way from so cheap a commodity as silver, why does he not set up a little place of his own; for, according to his own statements, if he keeps on hammering silver he will soon grow fabulously rich. We suppose he really poses as a philanthropist, and only desires to enrich other people, after having provided for himself in a quiet way out of the purchase money paid by those who are foolish enough to buy shares in his great syndicate. When we remember the extraordinary frauds which have been perpetrated upon the American public in the past in connection with ideas with an object less chimerical than those of Emmens, "the gold maker," we shall not feel surprised if he succeeds in inducing a large number of people to part with their dollars. We should then advise the worthy alchemist to seek "fresh fields and pastures new" as speedily as possible, lest, instead of hammering silver, he gets hammered himself.

Thomson and Varley Slides.—During the past two or three years extensive use has been made of the Thomson and Varley slide-bridge, especially for cable tests on board ship. Improvements in the mechanical construction of the contact arms have increased the confidence of electricians in this form of apparatus; and experience has shown that with well-arranged connection straps and binding screws it adapts itself to nearly every electrical cable test, with great saving of time. Moreover, it is able at once to be transformed into an universal shunt. Dr. A. Tobler, in the *Jour. Télégraph*, 22, pp. 4—9, 1898, brings together several interesting details bearing on the history of the slide-bridge. The fundamental idea seems to have been contained in an apparatus described by Sir William Thomson in Patent No. 2,047, p. 35, 1862; but the vernier is due to C. F. Varley, and is accredited to him by du Moncel in a "Notice sur le Câble Atlantique" (Paris, 1869). The first Thomson and Varley "bridge" was constructed in 1866 by Cornelius and S. Alfred Varley, at 66, Roman Road, Islington, at a cost of £150. Such an instrument was to be seen at the Eastern Telegraph Company's station at Porthcurnow, as recently as 1883. The two series of coils were placed in long boxes, on the top of which were straight rods carrying the sliders. Dr. Tobler expresses surprise that this apparatus was not patented, for Varley appears to have been a frequent visitor at the Patent Office; in 1859 (Patent No. 1,509, p. 7) he actually obtained patent rights for a "principle," *i.e.*, the principle of the "loop test." His object, no doubt, was to secure priority of invention. The circular form of slide-bridge, with alternate concentric contacts, was introduced in 1875. The general theory of the vernier system was stated by Dr. Tobler in 1881 (*Elektr. Zeitschr.* Vol. ii., p. 51), and independently, the same year, by H. R. Kempe. Mascart and Monnier, in their treatise on electricity, give an independent proof; and a short method is described in the ELECTRICAL REVIEW, Vol XXX., p. 286.

Improved Bit Stock.—A most useful angular bit stock, which will no doubt prove of great value to telephone construction men and electrical wiremen in general, has just been placed upon the market by Messrs. C. Meister & Co., Allentown, Pa. The illustration (taken from the New York *Electrical World*) shows that by pulling out the set pin this tool can be deflected and blocked at the various angles shown



by the dotted lines. The limit, which is beyond the right angle, works as easily as on all the others. The firm claims that by the large gear attached to the chuck a 1-inch hole can be bored with less power than a ¾-inch hole with any other angular bit stock in the market. The ingenuity and simplicity of the design speak for themselves. The use of this bit stock will certainly eliminate one of the heretofore disagreeable features of inside electrical wiring of all descriptions.

Electrical Conductivity in Mixed Solutions of Electrolytes.—There is an interesting experiment described in the *Zeitschrift für Physikalische Chemie*, 1898, Vol. xxv., page 115, by K. Hopfgartner. In a solution of two different electrolytes, if n_1 and n_2 be the concentrations of the cations, and u_1, u_2 their migration velocities, then the ratio of the number of their respective cations passing in the same time across any section towards the cathode is given by

$n_1 u_1/n_2 u_2$. If this ratio, d_1/d_2, can be directly obtained from the alteration of the anode liquid, then if the migration velocities are known, the concentrations of the ions can be calculated: $n_1/n_2 = u_2 d_1/u_1 d_2$. The ratios of the concentrations of the hydrogen and sodium ions were thus obtained in the case of mixtures of equally concentrated solutions of sodium chloride and hydrogen chloride, and the values compared with those obtained by means of Rudolph's expression. The agreement was satisfactory, indicating that the admixture of these highly dissociated solutions has little effect on the dissociation. In the case of mixtures of similar hydrogen chloride and barium chloride solutions, however, the agreement was not good, probably owing to the assumption that the dissociation of the barium chloride is entirely to Ba'' and Cl ions. The values of the transference ratios of the ions was also obtained for the three salts examined at different dilutions. For sodium, the transference number increases with increasing dilution, whilst for both barium and hydrogen the reverse was found to obtain. The quantity of the cations deposited as a result of the purely electrical action was calculated from these numbers, and the results were found to agree well with the silver deposited in a voltameter included in the circuit.

Electric Lighting of Balmoral Castle.—A daily paper says that the Queen will probably defer her departure from Osborne beyond the date originally fixed, as the work of lighting Balmoral Castle with electricity, which is now in progress, will not be completed until the beginning of September. There are to be 600 lamps, and there will be over 1,000 when the electric light is extended to the outbuildings. A brief description of this installation was given on page 46 of our issue for July 8th.

Summer Schools for Mechanics.—One of the directions of University Extension in America is the summer school for mechanics. We learn from *Machinery* that three American colleges are offering a summer course in mechanical engineering open to outsiders. These are the Cornell University, the Massachusetts Institute of Technology, and the Case School of Applied Science at Cleveland, Ohio. We may take it for granted that the working mechanics for whom this course is intended will be of the right quality to profit by the instruction, otherwise they would scarcely be found attending special classes in American summer weather. Correspondence schools and evening classes in winter lack completeness, and our contemporary considers that one or more summer courses at a well equipped college will be valuable to students of an ambitious turn. The difficulty is in the lack of preparation of many of the students which might act as an obstacle to the free opening of the summer classes to outside mechanics, but it is argued that against this is to be placed the advantage to the professors and ordinary students of contact with men fresh from the workshop. The interchange of ideas should be beneficial, and the practical mechanics ought to be able to more than make up for any delay that they may otherwise cause. A writer who recommends mechanics to take up with the course, quitting work for the time, and, perhaps, living far away from home, does so chiefly on the ground of increased earning capacity. It is, perhaps, fortunate that everyone is not of a mind to study, or the better positions would all be crowded up. Just to what end technical education will lead us is difficult at present to see, and can hardly be estimated until such time as the full effect has become apparent. So far it has not resulted in much improvement in handicrafts. The early attempt at improving handicraft which was made by the late Sir Joseph Whitworth has had no result such as he hoped to see. Whitworth scholars have, in few cases, become skilled workmen. Many of them have simply degenerated into professors and have been entirely out of touch with practice; others have become draughtsmen; others occupy good managerial positions, but none have become what the founder intended—high-class well-paid workmen. Where a mechanic aims to acquire superior knowledge to his fellows he does so in order that he may drop the hammer and the chisel, not that he may be able to use them better. In a manufacturing engineers' shop there is little chance in the ordinary work for a superior man to make use of his knowledge. He generally seeks improvement by a change. It is well to recognise that technical education will not, for the present, do much to change the rank and file, though it may help the more deserving and render them able to lift themselves a grade above their starting point.

Action of Drop Electrodes.—During the formation of the drop in a mercury-dropping electrode, the surface of separation of mercury and calomel solution is increased, and hence, if the solution tension of the mercury is less than the pressure of the mercury ions, the latter pass into the drop, whilst the equivalent quantity of chlorine ions form the double layer at the surface until the normal potential difference is reached. When this drop reaches the lower surface of mercury, already in its normal state, the mercury and chlorine ions again pass into solution reforming calomel, so that it follows that the concentration of the calomel decreases above and increases below. By independent mercury electrodes in the electrolyte at the upper and lower portions, and a mercury electrode in an independent calomel solution, the concentration was found to change in the manner expected. The potential difference soon attains a constant value, and, if the dropping be then stopped, the E.M.F. falls, slowly if undisturbed, but immediately if the liquid be stirred. Owing to the formation of a mercury emulsion in the liquid, the liquid does not reach a normal state, even by remaining 24 hours without stirring. The effect of change of level of the electrode, diameter of dropping tube, and head of mercury were investigated, and the concentration of the mercury ions in the neighbourhood of the dropping tube was found to be about one-tenth that of a saturated calomel solution, that is, about $1{\cdot}1 + 10{\cdot}7$ normal. The above is an abstract of a paper in the *Zeitschrift für Physikalische Chemie*, 1898, Vol. xxv., page 265, by Wilhelm Palmaer.

Source of Error in the Determination of the Heat of Dissociation of Electrolytes.—The equilibrium equation in the case of a dissociation process is $c_2^x . c_3^y / c_1 = k$, where x and y are the numbers of the different ions resulting from the dissociation. The concentrations, c_1, c_2, and c_3, are given by the expressions $(1 - a)\, c/(1 + \beta)$, $x\, a\, c\, (1 + \beta)$ $y\, a\, c/(1 + \beta)$, that is, are functions of β, the degree of dissociation of the solvent. Hence, since by temperature change the degrees of dissociation of both solution and solvent are directly altered, it follows that the degree of dissociation, a, of the solute undergoes, not only the direct change due to temperature, but also a secondary change due to the alteration of the concentration. On this account, the heat of dissociation is not accurately given by the ordinary expression $q = \mathrm{R}^{\mathrm{N}}\, \mathrm{T}^2\, d \log. k/d t$, but by an extended expression, $\mathrm{R}\, \mathrm{T}^2 \{d \log. k/d t - (x + y - 1)\, d \log. (1 + \beta)/d t\}$. In the case of potassium, the author shows that the omission of the second term leads to an error of 100 per cent., its value being calculated by the aid of Ramsay's determinations of the association factor of water at different temperatures. The above is an abstract of a paper in the *Zeitschrift für Physikalische Chemie*, 1897, Vol. xxiv., page 608, by J. J. van Laar.

The Fascinations of Electricity.—The following letter is word for word as we received it, the name and address only of the writer being withheld:—"Dear Sir,—Would you kindly give me the following information, I am desirous of entering the Electrical Engineering Proffesion either as Central Station or Consulting, I have a fair knolage of the Theory, but desire a Good Practical Training, could you recomend any College for this Purpose, if not an apprenticeship at a Works for a small Preinem. I am 21 years of age, but have a decided interest in the Work, I have no knolage of Mathematics at Present but would start at once, if you would advise me to procede. I am not at present in an Engineering Trade. Would you advise me to procede. I am Willing to give 3 to 5 years in the attempt. Thanking You in Anticipation I remainn Your in Earnest, —— ——."

Apparatus for Examining the Spectra of Gases.—In the *Comptes Rendus*, Vol. cxxiv., page 525, Marcellin P. E. Berthelot describes a new apparatus for facilitating the examination of the spectra of gases under an atmospheric pressure. Although inferior to the ordinary Plucker tubes as regards definition of the lines, the simplicity of construction and ease of manipulation make it possible to include an examination of the spectrum in the ordinary qualitative analysis of a gas. The apparatus consists of a straight glass tube, 10 to 12 cm. long and 7 to 15 mm. broad, closed at one end, into which a platimum wire is fused. A second and much narrower tube is bent in the form of a V, and has a platinum wire running through its whole length and projecting at both ends. At one end, which serves as one of the poles for the electric discharge, the glass is fused round the wire; the other end can be connected with the coil. The sealed limb of the second tube is fitted into the first tube by means of a cork, in such way that it can slide up and down, so that the distance between the two platinum wires can be adjusted. A short capillary tube must also pass through the cork, or there must be a notch in its side to allow for the expansion due to the sparks. The straight tube is filled with mercury, placed in a small mercury trough, and a small quantity of the gas to be examined is passed into its place. A condensed or uncondensed spark is passed between the platinum wires, the distance between them being adjusted to give the best result. The discharge should be frequently interrupted and a condensed spark should be avoided if possible.

Electrosynthesis.—In a recent issue of the *American Journal of Science*, (IV.), 4, 51, there is a paper by William G. Mixter on this subject. He says that mixtures which readily explode when subjected to an ordinary electric spark, may not do so under the influence of the electric glow in an ozonising tube. Thus, oxygen and hydrogen in the ratio 1 : 2 at 235 mm. pressure did not explode, but combined slowly. Various explosive mixtures were therefore subjected to the glow discharge in eudiometer tubes and the rates of combination determined, but as no determination of the current strength were taken, the relation between the rate of combination and the quantity of electricity discharged was not obtained. Hydrogen and oxygen were found to slowly combine, carbonic oxide and oxygen combined more rapidly, and even when perfectly dry combined slowly. Methane and oxygen combine in a manner consistent with complete combustion, but in the case of mixtures of acetylene with oxygen, ethylene with oxygen, and ethane with oxygen, the quantity of the latter gas used is less than that required for complete combustion, whilst small quantities of the hydrocarbons were decomposed with the formation of acetylene. Very little ozone is formed during the discharge, and the oxidation cannot be due to its formation. The author does not consider the combination to be due to the union of ions, but to the inter-action of the molecules themselves, which are made active by the glow discharge.

The Blackheath Tragedy.—The large number of readers of the Electrical Review who were acquainted with the late Mr. Tyler, secretary of the India-Rubber, Gutta-Percha, and Telegraph Works Company, will have heard with profound horror of the death of his widow under such brutal and revolting circumstances. Mrs. Tyler had recently devoted much time and considerable sums of money to help the poor and needy of the district in which she resided. Since her husband's death 18 months ago Mrs. Tyler had continued at the same residence as during his lifetime, No. 67, Kidbrook Park Road, Blackheath, S.E., and so far as appears to be known up to the present, the case is one of strangulation by a burglar. No one can have a greater desire than ourselves that the murderer of this kindly and benevolent lady will be speedily brought to the bar of justice, and to her sorrowing relatives we tender our respectful sympathy.

The Forthcoming Como Exhibition.—The Board of Trade have received through the Secretary of State for Foreign Affairs a copy of the general rules and programme of the Exhibition of Electric Appliances which is to be held at Como next year. This may be inspected on application to the Board of Trade on any day between the hours of 11 a.m. and 4 p.m.

The Electrical Conductivity of Dilute Solutions.—For a long time it has been realised that our knowledge of the intimate workings of electricity may be enriched by studying the physical properties of solutions, and especially of dilute solutions, in which the conditions are very favourable for investigation. Consequently, much attention has been devoted to this branch of research, and amongst recent papers we may notice one by R. Schaller in the *Zeitschrift für Physakalische Chemie*, xxv., 497, who has been investigating the electrical conductivity of dilute solutions at various temperatures up to 100° C. In order to avoid the action of water on glass at high temperatures, a platinum vessel was employed; but it was found that, in the case of acids and neutral salts, vessels made of Jena glass might be used. The measurements at 25° before and after heating were found to differ by about 3 per cent., and this difference was ascribed to changes in the electrodes, as it became considerably less after the electrodes had been used frequently at the high temperatures. The conductivity of the water employed rose from about $1 + 10^{-6}$ at 25° to about $2{\cdot}6 - 2{\cdot}8 + 10^{-0}$ at 99°. An approximately equal temperature coefficient was obtained with solutions of potassium chloride, sodium chloride, potassium nitrate, and sodium nitrate, being about $2{,}000 - 2{,}300 + 10^{-6}$, and increasing slightly with the temperature. For hydrochloric acid the coefficient is much smaller, $1{,}200 - 1{,}400 + 10^{-5}$, and decreases with rise of temperature. The migration velocities of the various ions are calculated for temperatures up to 100°, the assumption being made that the velocities of the potassium and chlorine ions are equal at all temperatures. The sodium salts of cinnamic, orthotoluic, paratoluic, benzoic, orthoiodobenzoic, metiodobenzoic, orthonitrobenzoic, metanitrobenzoic, parachlorobenzoic, and anisic acids were also examined. The molecular conductivity was found to increase with rise of temperature, but at a diminishing rate, in some cases reaching a maximum, and then decreasing; the degree of dissociation, however, as well as the heat of dissociation, which is calculated from the temperature coefficient, was found in each case to decrease with rise of temperature, the heat of dissociation frequently changing at the higher temperatures from a positive to a negative value.

Electric Launch.—The *Shipping World* says that the *Vril* electric launch has considerably exceeded the Russian Minister of Marines' contract requirements. Built and equipped, electrically, to give a half speed of 4½ knots for 10 hours, the little vessel at her final trial before Captain Grigorovitch, the Russian Naval Attaché, gave a half-speed of 5½ knots with apparently sufficient energy left in her accumulators to warrant her builders in stating she would have kept up the 5½ knots for 20 hours. Owing to want of time, an exhaustive trial was not made, but the data obtained enables the makers to guarantee 5½ knots for 15 hours without exhausting the batteries.

Are Solar Radiations Transformed into Electricity?—With a view to solving this question, a very interesting piece of work has recently been carried out by A. Bach in connection with the reduction, electrolysis and photolysis of carbonic anhydride. Lieben has shown that when carbonic anhydride is reduced by sodium amalgam in an alkaline solution, formic acid is the sole product. The author finds that when carbonic anhydride in aqueous solution is reduced by means of hydrogen occluded in palladium, some formaldehyde is also produced. In the electrolysis of carbonic acid the chemical changes are represented by the equation $3\,H_2CO_3 = 2\,CO_3 + 2\,H_2O + CH_2O = 2\,H_2CO_3 + O_2 + CH_2O$, and the author has shown (Abstr., 1893, 483) that, under the influence of sunlight, the acid decomposes thus: $3\,H_2CO_3 = 2\,H_2CO_4 + CH_2O = 2\,H_2CO_3 + O_2 + CH_2O$. Assuming that in the electrolysis the acid is reduced by the liberated hydrogen, the decompositions by electrolysis and photolysis are identical, for it is obvious that the group $CO_3 + H_2O$ is equivalent to the percarbonic acid H_2CO_4, but it remains uncertain whether the solar radiations merely act in the same way as electricity or are transformed into electricity. The original, of which the above is an abstract, may be consulted in the *Comptes Rendus*, cxxvi., 479—481.

The Importance of Proper Methods of Illumination.—The *Electrical World* abstracts a paper just re d by F. A. Bowman before the Canadian Electrical Association Convention on this subject. The author says it should be distinctly borne in mind, especially by the smaller companies, that to do a growing and really successful business something more is necessary than to merely induce your customer to put in so many lamps, and then to get as much pay as you can from him for them. It is now clearly demonstrated beyond a peradventure that the margin of profit is as narrow in the central station business as in any other, if not a great deal narrower, and that even when there is no competition from gas or a rival company, the closest economy and best management are necessary to yield a profit to the shareholders and provide for future contingencies. In view of this the manager should realise that he must educate his *clientèle*, and give them the best satisfaction in every way. Too many managers are satisfied when they have succeeded in persuading a customer to take a certain number of lights. If in addition they are giving full pressure at the lamps and a reliable service they consider that their duty to both the company and the public is done. Now this is a wrong principle. Attention should be paid to the purpose for which the light is required. Take, for example, a shop. The purpose for which it is to be used, its size, the height of ceiling, finish of the walls, kinds of goods to be displayed and sold, arrangement of counters and show cases—all must be noted and considered. It is useless to attempt to light a modern drug store and a ready-made clothing store in the same way, and expect equally satisfactory results in both cases. The manager should be looked upon as an authority on methods of lighting, and if he gives the matter a reasonable amount of attention, he very soon will be. He must remember that he is a dealer in light, and to be a successful one, must know all about it—how it is best used, and what are the latest fashions in it. Education of his customers is a very material part of the work of every successful manager in the electrical business, and is one of the principal reasons why the business cannot be properly carried on by some one who has a number of other interests to look after as well. The manager must study this question of proper illumination, so as to master the main principles necessary to a clear understanding of it. He must study his customers so as to know what their tastes and requirements are. He must carefully watch the advertisements in the technical journals and the catalogues that are so plentifully distributed, and many of which contain accurate and valuable information, and then correspond with the advertisers to see if the articles that strike him as suited to some of his customers can be brought within their reach. Then he must canvass carefully and patiently, and if he fails one year must try again the next, because by that time he will know better how to work, his customers' ideas will have advanced somewhat, and possibly prices will have dropped a little.

The Automobile Club.—A daily paper says that the amalgamation of the Self-Propelled Traffic Association with the Automobile Club having been effected, at a recent extraordinary general meeting of members the following were added to the club committee:—Sir David Salomons, Hon. C. S. Rolls, Mr. Andrew W. Barr, Mr. Alfred Bird, Prof. Vernon Boys, Mr. R. E. B. Crompton, Mr. Walter Hancock, Mr. Bayntun Hippisley, Mr. J. T. Hopwood, Mr. Alfred L. Jones, Mr. Edmund Macrory, Mr. Harry Melville, Mr. E. Shrapnell Smith, Mr. E. R. Shipton, and Mr. John J. Thornycroft. The Automobile Club has its club house at Whitehall Court, and has over 360 members, of whom nearly 100 own motor vehicles.

Motor Vehicle Trials.—The judges, Sir David Salomons, Mr. Boverton Redwood, Mr. S. B. Cottrell, Prof. H. S. Hele-Shaw, and Mr. Henry H. West, who were appointed to award the prizes in connection with the trials of motor vehicles for heavy traffic held at Liverpool from May 24th to 27th last, have awarded the first prize of £100 to the Lancashire Steam Motor Company, Leyland (vehicle No. 5); the second prize of £75 to the Liquid Fuel Engineering Company, Limited, East Cowes (vehicle No. 1); and the third prize of £50 to the Steam Carriage and Waggon Company, Limited, Chiswick (vehicle No. 4—four-wheeler). The judges' full report on the trials is still in course of preparation, and will be issued later in the year.

Obituary.—We regret to hear of the death, which occured on 12th inst., of Mr. John Thomas Gent, at the age of 56 years. In 1895, Mr. Gent retired from the well-known Leicester firm of Gent & Co., and removed to Flushing, Falmouth. In November last he proceeded to Birmingham to place on the market several inventions connected with illuminated advertising, and he had lately arranged for one patent to be worked by the Electric Night Advertising Company, Limited, which business will be continued by his son, Mr. W. A. Gent. The late Mr. Gent's name is associated with a number of electrical inventions.

NEW COMPANIES REGISTERED.

Fownes Forge and Engineering Company, Limited. (58,556).—This company was registered on August 13th with a capital of £50,000 in £1 shares, to acquire and take over as a going concern the business now carried on at Newcastle-on-Tyne, Cardiff, and London, under the style or firm of "George F. Fownes & Co.," and to carry on the business of iron and steel shaft makers, marine engineers, forge masters, mechanical and electrical engineers and contractors, boiler makers, iron, steel and metal founders, shipbuilders, metal workers, smiths, &c. The first subscribers (each with one share) are:—H. F. Fownes, Goldspink Hall, Newcastle-on-Tyne, forgemaster; H. Macarthy, 180, Newport Road, Cardiff, engineer; B. R. Beale, Bucklands, Teddington, engineer; O. Young, M.P., Hare Hatch House, Twyford, Berks.; G. P. Macarthy, 9, Dean Street, Newcastle-on-Tyne, shipowner; A. W. Scott, Great Western Railway, Paddington, civil engineer; G. W. B. Porter, 2, Wardrobe Place, Doctor's Commons, E.C., solicitor; W. Harley, South Lawn, Fountainhall Road, Edinburgh, retired. The number of directors is not to be less than three nor more than five; the first are: Henry Fownes, Harry Macarthy, and Bertram Beale. Qualification, £1,000; remuneration, Henry Fownes, £600 per annum; Harry Macarthy and Bertram R. Beale, £450 each per annum.

H. Greene & Sons, Limited (58,554).—This company was registered on August 13th, with a capital of £27,000 in £5 shares, to acquire and carry on the business of gas engineers and fitters, electrical engineers and electricians, carried on as "Henry Greene and Sons," at 153 and 155, Cannon Street, and 73, Farringdon Road, London, and to enter into an agreement with Benjamin Horton. The subscribers (with one share each) are:—A. E. Podmore, Daysbrook Road, Streatham Hill, S.W., manager; C. J. S. Mickle, 18, Woodstock Road, Finsbury Park, manager; A. E. Mickle, 61, Alderney Street, Pimlico, clerk; H. Smith, J. R. Hanson, C. W. Rooke, 61, Gracechurch Street, E.C., chartered accountants; H. E. Hammerton, 9, St. Michael's Road, Stockwell, S.W., clerk. The number of the directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £250; remuneration, £315 per annum, divisible.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Warrington and District Electric Light and Power Company, Limited (55,890).—This company's statutory return was filed on June 8th, when 302 shares were taken up out of a capital of £2,000 in £1 shares. 50 shares are considered as paid, and 15s. per share has been called and paid on the others.

Spanish Telephone Company, Limited (41,589).—This company's annual return was filed on June 20th, when the whole capital of £16,000 of £1 shares had been taken up and considered as fully paid.

Bailey, Grundy & Barrett, Limited (38,004).—This company's annual return was filed on June 10th, when 843 shares were taken up out of a capital of £10,000 in £5 shares. £5 per share has been called, and £4,205 received, leaving £10 in arrears.

CITY NOTES.

Imperial Tramways Company.

The ordinary general meeting of this company was held on Monday last at Bristol, Mr. Geo. White presiding.

The Chairman, in moving the adoption of the report, stated with regard to the London United Tramways, Limited, in which the Imperial Company held a considerable number of shares,

the year had been a stirring one. The London Company had made a distinct advance during the past six months, having been fortunate in obtaining an Act of Parliament to authorise important extensions of the system, together with overhead electrical powers on the greater part of the existing line. The Light Railway Commissioners had also granted an order, which was now awaiting the confirmation of the Board of Trade, to authorise a further extension of the lines from Hanwell to Uxbridge town, so that during the present year the company would doubtless be in possession of authority to put into work overhead electrical traction of something approaching 20 miles of line, when the London United Tramways would have one of the most complete systems of electric traction in the country, and rank as the pioneers of electric traction in London. With regard to the small portions within the county of London, he had great hopes that the London County Council would yet be content to fall into line with all the other authorities, and permit the installation of the overhead system on those portions. The opening next year of the Central London Electric Railway, which terminated at the commencement of the London United Company's lines, could not fail to be a great advantage to the United system, so that he looked forward to advantage accruing to the latter company's undertaking. A start with the work of reconstruction would be made forthwith; indeed, some of the material was already ordered, so that he looked forward with confidence to a fair proportion of their electric tramways in London being opened for traffic next year. As to the opening of the Middlesbrough, Stockton, and Thornaby electric tramways, he said the undertaking was exceeding their anticipations. As to the accounts before them, they had not had to dip into their dividends' equalisation fund to the extent he expected last half-year. The amount taken from the fund was only £1,150, leaving still £3,000 to credit, so that the total reserve fund now amounted to £43,000, which was a very creditable one, having regard to the proportion it bore to the share capital. The dividends proposed were at 6 per cent. on the preference, and 6 per cent. per annum on the ordinary shares. The motion was adopted.

A special meeting was subsequently held, at which it was agreed to write up the ordinary shares from £6—to which they had been written down by the present board's predecessors many years ago—to £10, the chairman stating that the alteration was fully justified by the state of the company's assets, which included the large profit made on the Dublin Southern Tramway shares. He added that advantage would be taken of the formal winding-up and reconstitution of the company to improve the status of the preference shares by making them cumulative as to dividend and capital, and the change would enable holders of ordinary shares to obtain a better price. The chairman gave figures showing that in the immediate future at least 6 per cent. per annum would be paid on the enlarged capital, whilst the development of the various concerns in which the company was interested indicated that this dividend would be still further augmented in the near future. The special resolutions authorising the voluntary winding-up and reconstruction of the company, to allow of the ordinary shares to be written up from £6 to £10, were then put and adopted, and Mr. S. White (secretary of the company) was appointed liquidator for the purpose of such winding-up.

Consolidated Telephone Construction and Manufacturing Company, Limited.

YESTERDAY (Thursday) afternoon an extraordinary meeting of the above company was held at Winchester House, to consider the present position of the company, and to pass resolutions as to the continuance or closing of the company's business.

Mr. C. L. FITZGERALD, who presided, explained that all the efforts of the company to get increased orders had failed, and he saw little hope of doing business unless the municipalities started telephone exchanges, when they might do something. It was for the shareholders to say whether they should go on or not.

After a long discussion, Sir ALEXANDER ARMSTRONG moved that an expert be obtained to look into the business of the company and as to the expenses of the present management, and that the meeting be adjourned for a report, and that three shareholders be appointed to act with the board in the matter.

It was eventually agreed that Mr. Woolley, Mr. Lawson, and Mr. Stoop (shareholders) should meet Sir Alex. Armstrong and Mr. Henry Gréwing (directors), and with the assistance of an expert inquire into the business and report at a further meeting of shareholders.

Bristol Tramways and Carriage Company, Limited.

AT the half-yearly meeting of this company, held at the Grand Hotel, Broad Street, on 10th inst., under the presidency of Mr. C. H. Low, the CHAIRMAN, after dealing with the general business of the company, said:—

"Gentlemen, I have no desire to fight our battles over again with regard to the extensions and electrical power. You may well imagine that, if anything, your directors have been well nigh surfeited with this subject during the past year or two; but all the months of anxiety and hard work which we have encountered over this business, and which has naturally fallen upon the managing director more than the other members of the board, are well repaid by the fact of our having secured two such important Acts as those to which the Royal assent was given on July 25th. The Extensions Bill, as many of you are aware, will enable us to carry our lines into important new districts, and to extend our older tramways sufficiently to make them much more valuable to the company, and useful to the public. For instance, you can all appreciate the immense advantage which will accrue to the public who go to the Downs, by their being carried right up to the edge of the Downs instead of being dropped near St. John's Church, at Apsley Road. There can be no question that this extension alone will mean an important addition to the summer traffic to and from the Downs, whilst the line which will go off in the direction of Redland Road and join up with the Horfield line at Zetland Road will, we believe, prove of great utility. There are other lines, such as the extension to Brislington and Bedminster Down, which will materially assist in developing the sections already laid in those districts, and, on the whole, the addition of six miles of route length to the present system will well repay the capital outlay in connection therewith. But the most important feature overshadowing every other consideration in connection with our Parliamentary work of this session has been the securing power to work all our present horse lines as well as the extensions by electricity on the overhead trolley system. We have sufficient experience of the working of tramways by the overhead system of electricity to know that we shall be able to serve the public very much better than with the old form of horse traction, whilst to you as shareholders, the fact that the whole of our undertaking will be worked by electricity must materially aid the stability of the undertaking, and I think that as the result of the large amount of additional capital expenditure which will be necessary in connection with these important works, it is not unreasonable to hope that the shareholders may benefit materially. We propose to call up a further £2 10s. on the £5 paid shares in October, the balance being probably called up in January next. In addition to this, we shall, however, have to raise a further large amount of capital, possibly about £250,000 during next year in order to complete the works, and although nothing has yet been decided by the board, it is not improbable that we may recommend you to create 4 per cent. preference shares. The report will have explained to you that the directors are now busily occupied in preparing for carrying out the whole of the relaying of the present lines and the construction of the new ones, as also their electrical adaptation and the erection of the central power station at Counterslip. Our idea at present is to commence the work by reconstructing the lines between the Tramways Centre and Totterdown, and Bath Street and Tower Hill, seeing that we could connect up without any extra expense the cables to be laid in connection with these streets to our present St. George's power station, and thus open these lines without waiting for the erection of the central station. I should hope that our central station will be finished at some time during next year, and in the meantime two or three of the more important lines, such as Hotwells and Horfield, will be put ready, so that by the end of 1899 the major portion of our system in Bristol ought to be worked electrically, whilst I have no doubt that within two years we shall have completed everything, and have the whole of the undertaking, including the extensions, in complete working order as electrical tramways. This will only be done by the directors and officials applying themselves without cessation to the work involved, as it will be an exceedingly heavy one; but you will know that we all have our hearts in the work, and that everything that is possible will be done to carry out the conversion in a thoroughly efficient and business-like manner."

Monte Video Telephone Company.—An extraordinary general meeting will be held at the offices of the company, 2/8, Gresham House, on Thursday next, at noon, when the resolutions dealing with the re-arrangement of the company's capital, which were passed at the extraordinary meeting held on 10th inst., will be submitted for confirmation.

W. T. Henley's Telegraph Works Company, Limited.—The £25,000 of ordinary share capital in £10 shares offered to the shareholders of this company at a premium of £8 per share, was largely over-subscribed.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 13th, 1898, were £2,869 19s. 7d.; corresponding period 1897, £2,706 15s. 10d.; increase, £163 3s. 9d.

The City and South London Railway Company.—The receipts for the week ending August 14th, 1898, were £993; week ending August 15th, 1897, £837; increase, £86; total receipts for half-year, 1898, £6,785; corresponding period, 1897, £6,283; increase, £502. Mileage open, 3½ miles.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 13th, 1898, were £259 13s. 7d.; total receipts to August 13th, 1898, £4,571 6s. 5d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for the week ending August 12th, 1898, were £1,039 2s. 7d. (includes traffic from Haddington Road to D'Olier Street); corresponding week last year, £752 12s.; increase, £286 10s. 7d.; passengers carried, 146,304; corresponding week last year, 109,611; aggregate to date, £6,687 17s. 6d.; aggregate to date last year, £5,347 9s. 3d.; increase to date, £1,340 8s. 3d.; mileage open, 9 miles, against 8 miles last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 14th, 1898, amounted to £1,743; corresponding week last year, £1,516; increase, £227.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending August 12th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,808.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, August 10th.	Closing Quotation, August 17th.	Business done during week ended August 17th, 1898. Highest.	Lowest.
137,400l	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
923,960l	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	64 — 67	64 — 67	64	...
3,038,020l	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	115 —116	115 —116	116	115½
3,038,020l	Do. do. Deferred	Stock	...	...	...	15 — 15½	15 — 15½	15⅝	15⅜
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15¾— 16¼	15¾— 16¼	16 1/16	15¾
75,000l	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	...	...	111 —115	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	4 %	2¾— 3¼	2¾— 3¼xd	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297l	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	104⅜
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	7 — 8	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	15 — 16	15 — 16	15¼	15⅛
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000l	Do. do. 4½ % Debs., Nos. 1 to 6,000	50	4½ %	4½ %	4½ %	102 —105%	102 —105%	...	...
60,710l	Direct United States Cable	20	2½ %	2½ %	...	11 — 11⅛	11⅛— 11⅜	11⅜	11⅛
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100—103	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½ %	6½ %	7 %	17¼— 17⅜	17¼— 17⅜	17⅜	17⅛
1,295,000	Do. 3½ % Pref. Stock	100	...	...	...	101 —105	102 —106	104	102
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	5 %	100 —103	100 —103	...	...
1,302,615l	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	123 —127	124 —128	...	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	17¼— 17⅜	17¼— 17⅜	17⅜	17⅜
25,200l	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	99 —103	99 —103	...	...
100,500l	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	100 —103	100 —103	...	...
320,000l	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	123 —127	123 —127	...	...
35,100l	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	99 —103	99 —103	...	...
46,500l	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	100 —103	100 —103	...	...
300,000l	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	101 —104	101 —104	102	...
200,000l	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	4½ %	11⅜— 12¼	11⅜— 12¼	12	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16⅜— 17¼	16½— 17	17	16⅝
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	10 %	29 — 30	29 — 30	29⅜	29
160,000l	Do. do. do. do. 5 % Debs.	100	5 %	5 %	5 %	102 —105	102 —105	103	...
97,000	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	99 —103	100 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	51 — 54	51 — 54	53	52⅛
100,000l	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	109 —112	110 —113	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000	5	4 %	4 %	4 %	2¼— 2¾	2¼— 2¾	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5¼— 5½	5⅛— 5⅜	5⅜	5 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	15½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅛— 5⅜	5⅛	5⅛
1,329,471l	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100—105	100—105	103¼	103
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000l	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	8 — 9	8½	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4¼— 4¾	4¼— 4¾	...	...
146,733l	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106	103 —106	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	nil	nil	3¼— 4½	3¼— 4½	...	...
213,400l	Do. do. 5 % Debs.	100	5 %	5 %	5 %	100 —103	100 —103	103	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ¾	¼— ¾	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	104 —107	106	105½
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	12¼— 12⅜	12¼— 12⅜	12⅝	12 7/16
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	8 — 8½	8 — 8½	8⅜	8⅛
33,129	Do. do. do. Def. Ord.	7½	1 %	nil	½ %	4 — 4½	4 — 4½	4¼	...
389,521	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	105 —108	107 —110	109	107½
88,321	West India and Panama Telegraph	10	¾ %	1 %	¾ %	¾— 1	¾— 1	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	8¾— 9¼	8¾— 9¼	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 — 8	6 — 8	...	...
80,000l	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	104 —107	104 —107	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	105 —110	105 —110	...	...
160,100l	Do. do. do. 6 % Ster. Bonds	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	12 — 13	12 — 13 xd	12¼	12⅛
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5¾— 6¼	5¾— 6¼xd	...	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277	5	5 %	5 %	6 %	9 — 10	8½— 9½	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	113 —115	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000	10	5 %	7 %	10 %	24½— 25½	25 — 26	25 7/16	24⅞
10,000	Do. Prov. Certs. Nos. 90,001 to 100,000 £5	10	...	...	...	24½— 25½	24½— 25½	24⅝	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	16½— 17½	16⅝	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	125 —130	125 — 130	...	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	nil	13 — 14	13 — 14	13½	...
10,000	Do. do. do. Nos. 30,001 to 40,000 £6 paid.	10	...	...	...	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	14⅜	14 1/16
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	...	...	4 — 4½	5 — 5½	5 3/16	...
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	8½— 9½	8½— 9½	...	...
10,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	15½— 16½	15½— 16½	15 15/16	15½
220,000l	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	116 —120	116 —120	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	15 — 16	15 — 16	16	...
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	16 — 17	16 — 17	16½	16 5/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅜	...
50,000	Do. do. 4 % Deb. Stock Red.	Stock	...	...	4 %	105 —108	105 —108	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	3 — 3¼	3 — 3¼	3 3/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	7 %	9 %	12 %	15 — 16	15 — 16 xd	15 15/16	15⅜

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation August 10th.	Closing Quotation August 17th.	Business done during week ended Aug. 17th, 1898. Highest.	Lowest.
30,000	British Electric Traction	10	...	...	...	16⅛— 17	16½— 17	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £7 pd. (issued at £2 10s. prem. all pd.)	10	...	...	...	10½— 11	10½— 11	...	....
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅜— 2	1⅜— 2	1⅞	1 13/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102—105	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10⅛	10
129,179	Do. do. do. £6 paid	10	...	...	...	5⅜— 6½	5⅜— 6½	...	...
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4⅜	4¼— 4⅜	4⅛	...
630,000*l*	City and South London Railway	Stock	1 3/16 %	1 0/16 %	1⅛ %	70 — 72	70 — 72	70¾	70
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd.	10	...	...	...	2⅜— 3¼	2⅜— 3¼	...	....
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1⅞— 2¼	1⅞— 2¼	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	89 — 94	89 — 94	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5½%	6 %	2¼— 2⅜	2¼— 2⅜xd	2⅜	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5½%	6 %	4 — 5	4 — 5 xd	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	101 —103	101 —103	...	....
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2⅜— 2⅝	2⅜— 2⅝	...	...
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	...	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	106	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	21 — 22	21 — 22	21⅝	21 3/16
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	112 —117	112 —117	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21½— 22½	22½	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅝%	3½%	10 3/16— 10 5/16	10 — 10⅛	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15⅝— 16¼	15½— 16	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	...	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	100 —103	100 —103	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	123 —128	125 —130	128¾	128

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.

House-to-House, 4½% Debentures of £100, 106—108.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—15; 1st Preference Cumulative 6%, £5 (fully paid), 8—8½. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10%.

London Electric Supply Corporation, £5 Ordinary, 3¾—4¼.

*T. Parker, £10 (fully paid), 13¼.

Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 2½ per cent. (June 30th, 1898).

MARKET QUOTATIONS, Wednesday, August 17th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	29/-	29/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per ton	37/-	37/-	..
a Ammonia, Muriate (grey) ..	per ton	£19	£19	..
a „ „ (white) ..	per ton	£26	£26	..
a Bleaching powder	per ton	£6 15	£6 15	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£14	£14	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£16 10	£16 10	..
a Lead, Nitrate	per ton	£23	£23	..
a „ White Sugar	per ton	£30	£30	..
a „ Peroxide	per ton	£27	£27	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4d.	4d.	..
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	£6 10	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£8 15	£8 15	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	3½d.	3½d.	..

METALS, &c.		This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots..	per ton	£191	£191	..
c Brass Sheet, basis	per lb.	6¼d.		
c „ Tube, „	per lb.	7¼d.		
c „ Rod, „	per lb.	6¾d.		
China Clay..	per ton			
d Carbon (graphite)	per ton			
e Charcoal	per ton			
f Ebonite Rod	per lb.			
f „ Sheet	per lb.			
g Copper Bars	per ton	£62	£61	£1 inc.
g „ Wire (basis price) ..	per lb.	7¾d.	7¾d.	..
g „ Sheet	per ton	£62	£61	£1 inc.
g „ Rod	per ton	£62	£61	£1 inc.
h German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	5/3		
h India-rubber, Para fine ..	per lb.	4/4½ to 4/5	4/4½ to 4/5	..
i Iron, Charcoal Sheets	per ton	£18		
i „ Pig (Cleveland warrants)	per ton	41/11½	40/10½	1/1 inc.
i „ Forgings, according to size	per ton	From £11		
i „ Scrap, heavy	per ton	45/-		
i „ Wire galvanised No. 8 ..	per ton	£8 15		
g Lead, English Ingot	per ton	£13	£13 2 6	2/6 dec.
g „ „ Sheet	per ton	£14	£14	..
l Mica	per lb.	5/6	5/-	6d. inc.
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£7 12	£7 12	..
o Platinum	per oz.	£2 10		
i Steel, Magnet, according to description	per ton	From £15	to £40	
i Steel, Magnet, in bars		£58		
g Tin, block	per ton	£77	£77	..
g „ foil	per lb.	1/3	1/2	..
j Yarns, Cotton	per lb.	..	..	
j „ Flax	per lb.	..	..	
j „ Hemp, 3 ply 10 lbs. ..	per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£11	£11	..
j „ Manila, 24 thread ..	per ton	£29	£29	..
k Zinc, Sht. (Vielle Montagne brd.)	per ton	£24	£24	..

a Quotations supplied by Messrs. G. Boor & Co.
b „ „ „ The British Aluminium Co., Ltd.
c „ „ „ Messrs. Thos. Bolton & Sons.
d „ „ „ „
e „ „ „ „
f „ „ „ The India-Rubber, G.-P., and Teleg. Works Co., Ltd.
g „ „ „ Messrs. James & Shakspeare.
h „ „ „ „ Jackson & Till.
i Quotations supplied by Messrs. Bolling & Lowe.
j „ „ „ „ Henry C. Yeo & Co.
k „ „ „ „ Morris Ashby, Limited.
l „ „ „ „ Sanders, Wake & Co.
m „ „ „ „ W. T. Glover & Co., Ltd.
n „ „ „ „ Pormiston & Sons.
o „ „ „ „ Johnson, Matthey & Co.

A SAFETY THIRD-RAIL TRACTION SYSTEM.*

Owing to the unsightliness of overhead, the expense of underground and the danger of exposed conductors, there have been many attempts to get up a system in which the exposed conductor could be divided into short strips which could be energised only when current from them was desired, and when they were protected by the car standing over them.

Most such systems have been devised with magnetically operated switches which could be automatically closed and opened as the car passed over their respective sections, by currents passed in some way through solenoids controlling them. If such systems depend upon power-house current for the operation of the magnets their cars immediately become helpless if they drift over one section, taking no current, and thereby failing to pick up the magnetic switch. They are then cut off from the power-house current on which they depend to energise the section of rail with which they are in connection and are stalled helpless. For this reason, such systems are, as a rule, equipped with storage batteries in the cars which may act upon the solenoids, and through them close the main circuit supplying power-house current to the third rail, and thence to the car motors. Here another difficulty comes up, in that the solenoids cannot be connected between the conducting third rail and the tram rails, as between these two points there is a potential difference of 500 volts as soon as the switch is closed, and coils capable of resisting this high pressure are not energised sufficiently by the low pressure of the storage batteries. This involves the necessity of a fourth rail, or, in systems using instead of a rail a series of conducting studs and a runner under the car, involves another set of these studs and a corresponding runner.

The Safety Third Rail Electric Company, Temple Court Building, New York City, has a system devised by Capt. J. McL. Murphy which overcomes this last difficulty. He boldly places on his car a source of electrical energy capable of giving 500 volts direct current, and by this means he is enabled to connect the windings of his switches direct between the third rail and the tram rails, and thereby avoid the necessity of a fourth rail, or its equivalent. The system is shown diagrammatically in the accompanying line drawing, in which there is indicated a car truck, showing directly under the main wheel axles, two contact shoes

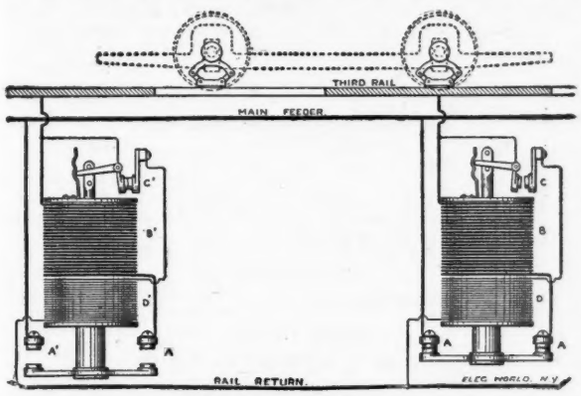


Diagram of Connections.

which bear upon the third rail. The latter is divided into sections with dead intermediate parts of any desired material between the live sections. For ordinary cars with an 8-foot wheel base and the standard overhang, the live sections are 8 feet in length, separated by dead sections 6 feet in length. In this way the forward shoe runs upon a new section before the trailing shoe has left the last one, and the sections which are rendered alive as soon as the shoe runs upon them are fully protected under the overhang of the car body and the platform.

As shown in the diagram, the shoe to the right is in contact with a section of the third rail, which is drawing current supplied from the main feeder through contacts, A A, and the coil B'. This latter holds up the plunger within the coil, and thereby maintains the circuit closed at the contacts, A A. As soon as the car moves to the left sufficient for the forward shoe to come on the next section of the third rail, the current will pass from the rear shoe, which is alive, to the forward shoe connected with it, thence through the contact, C', to the fine wire winding, D', which will lift the plunger and close the contacts, A' A', simultaneously opening the contact, C'. This will supply the car through the series coil, B', and forward shoe, so that when the following shoe leaves the section of the third rail on which it is shown, the current through coil B will cease, the plunger will fall, and the contacts, A A, will be opened, contact C being closed immediately thereafter, ready for the next car that may come along.

Obviously, if the car drifts over or in a section, it will take no current through the series coils, assuming that the lights and heaters are not in use. The magnets will, therefore, not be energised and the car must in some way supply current from itself for re-connecting itself to the power circuit. It will be noticed that in all cases the connections, C, of the fine wire winding are closed if the main connections are opened, and all that is necessary is to apply 500 volts between the tram and the third rails when the controller is put on the first point, to energise the fine wire windings, which will close the main circuit, and the current taken by the motors will pass through the coarse wire winding and maintain the plunger in its upper position. The auxiliary source of current is a storage battery of a few cells, connected to a small motor generator with a 10-volt winding on one commutator and a 500-volt winding on the other. The current necessary for the switches is but a fraction of an ampere, but the motor generator is preferably built of sufficient size to supply the lamps of the car in the evening. Obviously it is only used for a brief interval of standing, and the first instant of starting, until the power-house current comes across the terminals of the 500-volt commutator of the motor generator and tends at once to re-charge the battery.

The switches are made with carbon contacts which cannot bind or stick, and with gravity for a restoring force. The switches being only connected by wires with the rest of the system, can be grouped in manholes at convenient intervals, where they can be readily inspected and kept in order.

* New York *Electrical World*.

POWER STATION TESTS.*

A test of the power plant of the Brockton (Mass.) Street Railway Company, by Stone & Webster. The test was made to obtain the following information:—

Boilers—Evaporative performance; commercial horse-power; rate of combustion; rate of evaporation.

Engine—Speed regulation; power and efficiency.

Generator—Efficiency and capacity; temperature under load.

The boilers are of the vertical type, and are rated at 200 H.P. capacity each. They are 90¾ inches in diameter inside the smallest ring, and each has 222 tubes, which have an outside diameter of 2½ inches, and are 15 feet long.

The engine was made by the E. P. Allis Company, and is of the Corliss type, cross compound, condensing, and running at 110 revolutions per minute. The cylinders are 20½ inches and 38 inches by 48 inches, and the vacuum is obtained by use of a 24-inch by 12-inch Reynolds independent steam power air pump and jet condenser. Direct connected to the engine is a General Electric 10-pole 500-kw. generator.

The boiler feed water is taken from the city mains and is pumped through the main heater in the exhaust pipe, then through an auxiliary heater, which takes the exhaust steam from the feed pumps and the condenser cylinder, and then from the auxiliary heater directly into the boilers. The results of the tests are given below:—

Generator Tests.

The first tests were made on the generator alone, and may be divided as follows:—Measurements of resistances of armature and field coils; measurements of external characteristic; measurements of potential around commutator at no load and at half load; measurement of the efficiency of the generator by the stray power method.

1. The resistance of the armature was measured by placing it in series with a water rheostat and connecting it to the 500-volt bus bars. A current of about 100 amperes was then allowed to flow, and the drop in pressure between the armature terminals measured; 15 separate readings were taken, the armature being moved slightly after every fifth reading.

The resistance of the series coils was measured in a similar manner to that of the armature, and the resistance of the shunt coils was obtained by reading the current and the pressure at the terminals of the coils.

Resistance,	average armature	...	...	0·0189 ohms.
„	series field	...	...	0·0026 „
„	shunt field	...	...	47·1 „

All resistance measurements were made after the machine had been running a sufficient length of time to fully heat the coils.

2. To obtain the external characteristic, the machine was run at constant speed, and loaded by connecting a large water rheostat across the terminals. The current was gradually increased from 0 to about 800 amperes, and simultaneous readings were made of the current and voltage. The results obtained showed a gradual increase in voltage from 500 at 0 ampere to 510 volts at 800 amperes.

3. In order to get the curve of pressure around the commutator, a wrought-iron ring was made of slightly greater diameter than the commutator. This ring was mounted on the machine, so that its centre corresponded with the centre of the main shaft, and arranged in such a way that it could be turned by hand. An arm carrying a small carbon brush was fastened to the edge of the ring in such a way that the brush could be pressed down on the commutator when readings were to be taken.

The method of making measurements was as follows:—One terminal of a voltmeter was connected to one of the machine brush holders, and the other terminal to the arm and small brush on the edge of the ring; the brush was pushed down against the commutator, and a reading taken. The ring was then moved through an angle of 5° and another reading taken, and so on until measurements had been made entirely around the commutator.

The results obtained showed only a slight divergence from the true sine curve.

4. In order to test the efficiency of the generator, it was decided to run it as a motor, taking current from the 500-volt bus bars. The

* *Street Railway Journal*.

connecting rods were disconnected at the crank pins and the valve rods at the rocker arms, leaving the machine in such a condition that, on starting up, the only moving parts were the main shaft with the armature, fly-wheel, and crank discs, and the eccentric straps and valve rocker arms. The shunt field was then connected directly to the 500-volt bus bars, and the armature and series field coils were connected to the two bus bars in series with a large water rheostat. The resistance of the rheostat was then gradually decreased until the machine started, and was finally short-circuited when the machine was running at full speed.

The speed of the machine was regulated by the field rheostat in the shunt field circuit, and the inverse electromotive force by changing the pressure between the bus bars. It was then found that under the normal conditions of speed and pressure the currents and voltage were as follows:—

Voltage at terminals	569 volts.
Current through shunt field coil	9·5 amps.
„ „ armature and series field coil	47·5 „

The stray power (*i.e.*, the power required to run the machine free exclusive of C^2 R losses) was 27,100 watts. From the above, the commercial efficiency of the machine is found to be:—

	Per cent.
Efficiency at full load	90·8
„ at half load	87·0
„ at quarter load	78·7
„ at one-tenth load	60·4

The guaranteed efficiency of the machine is:—

	Per cent.
At full load	95·0
At half load	93·0
At quarter load	91·5

But, in considering the above results, it must be borne in mind that no allowance was made for the fact that the machine was driving the main shaft with fly-wheel and eccentrics when it was running as a motor.

It is interesting to compare these results with some tests made by Prof. R. C. Carpenter on the friction of engines. He tested five different engines, and in each case found that of the total engine friction 35 per cent., or over, was in the main bearings, or was wind friction on the fly-wheel. The average on the five engines was 41·7 per cent. To apply this to the Brockton engine, let us assume that the total friction of the engine is 10 per cent. of the rated power, which will be very approximately correct, and that 40 per cent. of the friction is in the main bearings and fly-wheel. This will give 30 H.P. required to drive the main shaft and fly-wheel, and subtracting this from the stray power and recalculating the efficiency of the generator, we find it to be:—

	Per cent.
At full load	94·6
At half load	94·3
At quarter load	91·8

This is, of course, only an approximation, but is sufficient to show that the efficiency of the generator must be very close to the amount guaranteed.

During the generator test the machine was run for a few minutes at an overload of 40 per cent., and was found to carry this without difficulty and without excessive sparking.

In connection with this test several interesting facts were noticed. It was found that the current required to start the machine from rest varied slightly, but averaged about 700 amperes. When the machine was first started up as a motor it was connected directly to the bus bars from which current was being taken for the electric road, the current being supplied by several generators belted to high speed engines. Under these conditions the current taken by the 500-kw. generator varied constantly, and part of the time it would supply current to the bus bars for fully a minute at a time. This was evidently due to the momentum of the fly-wheel. The changes in load on the line and the poorer regulation of the high speed engines varied the bus bar voltage, and some time was required for the large machine to change its speed and adjust itself to the new pressure. It was, therefore, found necessary to make the tests during the night, when there were no cars on the line. The momentum of the fly-wheel was also shown when the machine was disconnected from the circuit, as it was found that it required from 25 to 30 minutes for the machine to come rest after the switch was thrown.

These tests show conclusively that indicator cards taken on such an engine with varying loads give practically no idea of the actual output of the machine. If part of the load has just been thrown off, half the indicated horse-power may be used up in slightly speeding up the fly-wheel, and if the load has just been thrown on, a large portion of the output may be obtained from the momentum of the fly-wheel and not appear on the indicator cards. The fly-wheel on this engine weighs approximately 60,000 lbs.

Test of the Complete Plant.

After testing the generator, arrangements were made for the full load run and efficiency test of the entire new apparatus. For this purpose it was necessary to make a number of changes in the steam piping, and provide means for weighing water, &c.

The main steam header was first separated by having a blank flange inserted in one of the joints, so that the new part of the plant would be entirely independent of the whole. A temporary pipe was run from the old boilers to supply steam to the boiler feed pump and condenser for the new plant, and two platform scales were set up, one to weigh the boiler feed water, and the other to weigh the water discharged through the drip pipes from the steam piping. The water escaping from the drip pipes was weighed separately, in order to obtain the exact amount of steam delivered to the engine.

Four indicators were used on the engine, and were provided with electrical attachments, so that by pushing a button the cards would be taken simultaneously on all. The load for the generator was obtained by passing the current through a large water rheostat, in which two plates of boiler iron were hung in a solution of common salt. The current from the generator was measured by measuring the fall of potential between the terminals of a specially calibrated shunt.

The tabulated results of the foregoing tests are given in the following columns:—

The Boiler Test.

Date of trial	June 25th, 1897.
Duration of trial	10 hours.
Number of boilers in use	2

Dimensions and Proportions.

Grate surface of each boiler	33·18 sq. ft.
Grate surface, total	66·36 „
Water heating surface of each boiler	1,648 „
Water heating surface, total	3,296 „
Superheating surface of each boiler...	502 „
Superheating surface, total	1,004 „
Total heating surface	4,302 „
Ratio of water heating surface to grate surface ...	50
Ratio of total heating surface to grate surface ...	65

Average Pressures.

Steam pressure in boiler, by gauge, per sq. inch ...	112·3 lbs.
Atmospheric pressure per sq. inch	14·5 „
Absolute steam pressure in boiler per sq. inch ...	126·8 „
Force of draught in column of water beyond damper	0·40 „

Average Temperatures.

Of external air...	85 degs.
Of fire room	88 „
Of feed water before entering first heater	68 „
„ „ second heater ...	137·3 „
„ „ boiler	197·1 „
Of escaping gases after leaving boiler	554 „
Of steam	384·4 „

Fuel.

Moist coal consumed	10,149 lbs.
Moisture in coal	2·4 %
Dry coal consumed	9,966 lbs.
Wood consumed	458 „
Coal equivalent of wood	183 „
Total dry coal consumed, including wood equivalent	10,149 „
Total dry refuse	817 „
„ „ „	8 %
Total combustible	2,332 lbs.
Dry coal consumed per hour	1,015 „
Combustibles consumed per hour	933 „

Quality of Steam.

Number of degrees superheated	39 degs.

British Thermal Units.

Heat units absorbed by boilers per lb. of steam generated	1,021·4 B.T.U.

Factors of Evaporation.

Factor of evaporation for boilers	1·06

Water.

Total water pumped into boilers	98,119 lbs.
Water actually evaporated, corrected for quality of steam	100,007 „
Equivalent water from and at 212° F.	106,007 „
Equivalent water from and at 212° F. per hour ...	10,601 „

Evaporative Performance.

Water actually evaporated per lb. dry coal... ...	9·85 lbs.
Equivalent per lb. of dry coal from and at 212° F.	10·44 „
Water actually evaporated per lb. of combustible ...	10·72 „
Equivalent per lb. of combustible from and at 212° F.	11·36 „

Commercial Horse-Power.

On basis of 34½ lbs. of water from and at 212° F. per hour by boilers	307·3 H.P.
No. sq. ft. of total heating surface per horse-power	14 sq. ft.
No. sq. ft. of water-heating surface per horse-power	10·72 sq. ft.

Rate of Combustion.

Dry coal actually burned per sq. ft. of grate surface per hour	15·3 lbs.

Rate of Evaporation.

Water evaporated per sq. ft. of total heating surface per hour from and at 212° F.	2·47 lbs.
Water evaporated per sq. ft. of water heating surface per hour from and at 212° F.	3·16 lbs.

THE ENGINE TEST.

Duration of test	6 hours.

DIMENSIONS.

Diameter of high pressure cylinder....	20⅛ ins.
Diameter of low pressure cylinder	38 „
Stroke	48 „

SPEED

Total revolutions of engine (6 hours)	38,526
Average revolutions per minute	107

AVERAGE PRESSURES.

Atmospheric pressure per sq. in.	14·5 lbs.
At throttle by gauge „ „	112·0 „
At throttle absolute „ „	126·5 „
In receiver by gauge „ „	5·9 „
In receiver absolute „ „	20·4 „
Vacuum in inches of mercury	24·0

AVERAGE TEMPERATURES.

In steam pipe at throttle	370·7° F.
In pond from which condensing water was drawn...	71·3° F.
In condenser discharge pipe	106·0° F.

CONDENSER.

Diameter of air pipe	24 ins.
Stroke	12 ins.
Total revolutions of condenser (6 hours)	22,525
Average revolutions per minute	62·6

POWER AND EFFICIENCY

Average indicated horse-power	708·5
Total indicated horse-power-hours	4,251·0
Average electrical horse-power output	627·8
Total electrical horse-power-hours output	3,767·0
Efficiency of unit	88·6 %

STEAM CONSUMPTION.

Total steam supplied to engine	64,927 lbs.
Steam per indicated horse-power-hour	15·3 „
Steam per indicated horse-power-hour when engine is running with 125 lbs. initial pressure and 25 ins. of vacuum (calculated from indicator cards)	14·4 „
Steam per electrical horse-power-hour output ...	17·2 „
Steam per kilowatt-hour output	23·1 „

COAL CONSUMPTION.

Water evaporated per lb. of dry coal	9·85 lbs.
Coal per indicated horse-power-hour	1·57 „
Coal per electrical horse-power-hour output ...	2·4 „
Coal per kilowatt-hour output	2·4 „

TEMPERATURE OF PARTS AT END OF TEST.

Air of engine room	83·5° F.
Main bearing low pressure side	129·0° F.
Main bearing high pressure side	129·0° F.
Armature	146·0° F.
Commutator	146·0° F.
Field coils	129·0° F.

At the end of the eight-hour run a test was made on the engine regulations as follows:—The speed was taken at full load and found to be 108 revolutions, the load was then changed to 75 per cent. of full load and the speed found to be 109 revolutions. The load was next entirely thrown off the generator, and the speed went up to 112 revolutions. On throwing 75 per cent. on again the speed returned to 109 revolutions. After this the engine was run under full load, and the boiler pressure was gradually reduced from 125 lbs. to 110 lbs., and this was found to have no apparent effect on the engine speed.

It is also interesting to note that the coal consumption per kilowatt-hour output was 2·4 lbs. during the test. The test was made at full load, and this 2·4 lbs. is the coal consumption under the most favourable conditions.

In practice, where the load is constantly fluctuating, and is sometimes but a small proportion of the full load for considerable periods, a very much larger coal consumption is to be expected.

MINE SIGNALS.

In a paper read by Mr. Clements before the South African Society of Electrical engineers, attention is drawn to the various systems of signalling. The old-fashioned system is, of course, the hand-pulled rope and bell, or flapper, as used so much to-day in English coal mines, the difficulty of which is that in very deep mines there is apt to be an uncertainty in its indications, and the engine man cannot always tell if each pull of the rope has produced a sound. In America a pneumatic system is used, consisting of a line of pipe and an air cylinder about 6 inches in diameter by 9 inches long, with a piston movable by a lever which is employed to give a sudden push of air down the pipe line to blow a whistle all over the system. The pipe used is recommended to be at least 2½ inches, and even more for long distances. The pipe should be smooth inside, as it can then be talked through, which is not possible with rough pipe, although signalling can be effected through rough pipe. Though by no means perfect, electrical signalling seems to be, on the whole, the best.

If there are, say, balanced skips for which to arrange signals, there are three wires run down the shaft, two being connected to the poles of a battery, and the third, or middle wire, being used to connect all bells in series and ring them simultaneously when a circuit is made through any push on the system. All bells are, of course, to be placed between the middle wire and the same pole wire, and the pushes between the middle and other pole wire. A separate signal should be arranged from the pit mouth to the engine room, and *vice versâ*, for the driver could not otherwise tell whence the signal comes, whether from the top or the lower set of skips.

A bell at the pit mouth keeps the banksman informed as to what the skips below are doing. Communication with the signals below must only be possible *viâ* the engine driver's apparatus. The chief disadvantage of the system is, that the driver has no means of knowing the places of the skips except by the correctness of the signal given, but the author has never known of an accident, as the bells ring simultaneously through the mine when rung from any one place, and those at any level know thereby where the skip is and what it is doing.

In a second system a separate wire is run to each level, the two battery wires being run to each level also, and when a signal is sounded it rings only the bell at the one place and a bell or indicator at the mouth and in the engine room. This system simplifies the code of signals; the driver knows what he is doing, but the cost and complexity is increased. The first system is that which the author advises. The wires may be run in either iron pipes or wooden conduits of deal ⅜ths in thickness, run along the roof timbers in an incline, and coated in and out with coal tar, the wires, No. 18 S.W.G., and lead covered, being held in position by wooden cleats, and all bells and pushes being placed in wooden boxes. This system worked well for eight months, after which the settling of the shaft so stretched the wires that they broke, though no further trouble has since arisen. Though exposed to much acid water, the lead-covered wires had not been affected.

When conveyed in iron pipes trouble has been found from internally condensed moisture, and from grounding of the wires in the pipes.

The Robinson Deep and the Simmer and Jack discarded a pipe system, and installed a bare copper wire system on double petticoat insulators of porcelain. But little trouble has been experienced. The wires should be at least 7/18 S.W.G., and they should be shackled off at distances of each 100 feet, and a bight made in the wire to run off moisture. Below a bight in a shaft the wire continues not directly underneath the length above, but to one side. Armoured cables should be pure rubber, insulated with a lead covering to the conductor and a steel wire sheathing. Such a cable can be bent round corners without injury to any part. In vertical shafts it may be hung well up in a corner of the ladderway, and in inclines in an upper corner of the skipway. The author considers that armoured cable is the best for signalling purposes. He considers that one quadruplex cable is fully as good as a pair of duplex cables, *i.e.*, one for the pole wires, and one for the two middle wires. Steel-sheathed cable may carry its own weight in vertical lengths of 300 to 400 feet, the connections between the lengths being in watertight boxes.

At pump stations or landing stages, cable should be boxed in for 10 or 12 feet above landings, and on inclines cable ought to be removed from the risk of having hung on it lamps, tools, &c., and generally precautions taken against injury.

There is no satisfactory signal bell known to the author. Pushers, in general, do not give satisfaction. The galvanometer key is better. Pulls, likewise, are apt to be unsatisfactory, as they depend on springs, which are apt to fail by rust. For batteries, the secondary cell is preferable for cleanliness and compactness. The Leclanché primary is satisfactory if properly attended. Whatever form be employed, there should always be an auxiliary. The E.M.F. should range from 6 to 16 volts, averaging about.

Bells and pulls must be inspected weekly at least, and all contacts kept bright.

THE TELEPHONE COMMITTEE'S REPORT.

THE following is the text of the Report of the Select Committee on Telephones, published last week. The gentlemen composing the Committee were:—

Mr. Bartley.	Sir Reginald Hanson.
Mr. Griffith-Boscawen.	Sir Henry Howorth.
Sir Harry Bullard.	Sir James Joicey.
Mr. Cawley.	Mr. Nicol.
Mr. Cohen.	Mr. John Redmond.
Mr. Colville.	Mr. James Stuart.
Mr. Firbank.	Mr. Tully.
Mr. Fry.	Sir James Woodhouse.

Mr. Hanbury (Chairman).

TEXT OF THE REPORT.

Your Committee have carefully considered the evidence given before two Select Committees of this House in 1892 and 1895, and before the Treasury Commissioner at Glasgow in 1897, in addition to that taken by themselves during 20 sittings.

The Reference to your Committee is as follows:—

"To inquire and report whether the telephone service is, or is calculated to become, of such general benefit as to justify its being undertaken by municipal and other local authorities, regard being had to local finance; and, if so, whether such local authorities should

have power to undertake such service in the districts of other local authorities outside the area of their own jurisdiction, but comprised wholly or partially in the same telephone area, and what powers, duties, and obligations ought to be conferred or imposed upon such local authorities."

The principal questions, therefore, with which your Committee have thought it their duty to deal are:—

"I. Is the telephone service now, or is it calculated to become, of general benefit?

"II. Is the Post Office in any way hindered by legal agreement or by good faith from competing itself or through licenses with the National Telephone Company in exchange areas?

"III. Ought competition to take place, and should municipal and other local authorities be empowered to undertake a telephone service; and if so, upon what terms?"

In our opinion the telephone service—

(1) Is not at present of general benefit, either in the United Kingdom at large, or even in those limited portions of it where exchanges exist;

(2) Is not likely to become of general benefit, either in the country as a whole, or in existing or future exchange areas, so long as the present practical monopoly in the hands of a private company shall continue; and

(3) As it has already become of much more general benefit in other countries, affording less scope for its development than is afforded by the greater density of population and the greater wealth and commercial activity of the United Kingdom, so it is fitted to become in this country, if worked solely or mainly with a view to the public interest, a valuable instrument in further developing the trade and social life of the nation, towards which new means of communication have always hitherto so largely contributed.

Our trunk service, which is in the hands of the Government and is worked on the toll system, is the most expensive in Europe. The exchange service, which is almost wholly in the hands of the company, and chiefly confined to subscribers, is much behind that of some Continental countries. During nearly 20 years we have tried in turn, first, an unlimited competition, next, restricted competition, and, afterwards, an unregulated monopoly, in private hands. But the exchanges still remain limited, in the United Kingdom, chiefly to England, in England to urban districts, in urban districts to the commercial classes, among the commercial classes mainly to merchants and large tradesmen, and among them to those only who find it advantageous to become subscribers.

The present subscription system, with the subscribers' right of unlimited user, means this: that persons who are rich enough to pay a fixed annual sum, and who use the telephone sufficiently often to find such a payment advantageous to themselves, whose correspondents also pay a similar sum and use the service with similar frequency, can alone, or almost alone, avail themselves of this mode of communication. It is just as if the Post Office should decide to despatch telegrams only from persons paying an annual subscription, and to allow such persons, on payment of their subscription, to despatch, without further charge, any number of telegrams, requiring at the same time that telegrams should be addressed only to persons connected with the Post Office telegraphs by private wires.

Within the London area, containing a population of over 6,000,000 persons, there are only 237 call offices open to non-subscribers for the transmission of messages. In Stockholm there are 700 for a population of only a quarter of a million.

Even where call offices exist, a non-subscriber can, as a rule, only send messages. The message must, unless a previous arrangement has been made between the parties, be despatched to a subscriber, except where the sender and the recipient of the message are both in the same postal district or town. In that case the message is written down at the post office to which it is transmitted, and is delivered for a small charge by Express Messenger Service. This limited privilege appears, however, to be little known to the public, and has certainly been insufficiently advertised.

The Treasury minute of 1892 appears to your Committee to contemplate a much greater extension of this system of express delivery of telephone messages—a system which, worked in connection with an adequate supply of call offices, would throw the telephone service open to the public at large.

Clause 7 of the Treasury minute of 1892 is as follows:—

"The companies will connect their exchanges with the offices of the Post Office, in order that their subscribers may telephone messages—(*a*) For transmission over the public telegraphs; (*b*) for transmission through the post as letters; (*c*) for delivery as express letters; (*d*) that they may call for the service of express messengers; and may (*e*) request to be placed in telephonic communication with other towns by means of the trunk wires of the State."

The delivery of telephone messages as express letters was one of the advantages put forward by the Postmaster-General, Sir James Fergusson, in his speech of March 22nd, 1892, as a result of the contemplated purchase of the trunk wires by the Government. "The concessions which might be made to the telephone companies are mainly these: that messages might be transmitted by telephone and communicated to the public telegraph wires, so that there might be free communication between the two systems; that messages might be sent from any telephone subscriber to be delivered to his correspondent by the Post Office; that they might be sent by post as letters, or by express messenger service; that no charge should be made by the Post Office for the work of taking down the telephonic messages and despatching them by telegraph or by post," &c.

The present restriction of this more popular system does not appear to be called for by regard for the maintenance of the telegraph revenue. Mr. Preece, engineer-in-chief to the Post Office, in his evidence before us, clearly stated that in London the growth of the telephone service has been simultaneous with, and, indeed, has probably produced, an increase also of telegraphic messages.

In any case such a restriction prejudicially affects the revenue of the trunk wires of the Government, and confines the receipt of trunk messages to subscribers to the National Telephone Company, except in the few places where the Post Office has itself an exchange.

One obvious tendency of the present system is thus to limit the use of the telephone service as a whole, and especially of the trunk lines of the Government, to the company's subscribers, to the exclusion of, and at the cost of, the general taxpayer. Another result is to increase the rates to subscribers themselves, and these rates are, in fact, higher in this country than the rates paid in similar places abroad. A third result is the fact that fewer telephones are used.

Mr. Gaine, the general manager of the National Telephone Company, admitted to your Committee that the system of limiting the service almost wholly to subscribers, and giving to each subscriber an unlimited user—a system which is universal in this country and is adopted to a large extent abroad—had been based from the first on a wrong principle. The right system appears to us to be the one advocated strongly by Mr. Preece, and which Mr. Gavey, also an electrical engineer to the Post Office, has shown to be so successful in popularising and developing the service in Switzerland. Messages can be sent by non-subscribers from call offices, and delivered to non-subscribers by express messengers; but, in addition to this, just as some persons in this country hire private telegraph wires to connect them with the general telegraph service, and thus avoid the necessity of delivering messages at or receiving them from a telegraph office, so persons who wish to save the journey to a call office to despatch a telephone message, or to receive it direct instead of by a written message, can secure a private telephone in their house or office on payment of an annual sum of (after two years) £1 12s. For all messages actually sent, subscribers and the public alike pay the same fixed toll—smaller if the message is a local one, larger if it travels over the trunk wire; the price for all distances over trunk wires being in Switzerland the same. Each message sent by a subscriber is numbered, and an account against him is kept. It follows under the system that every telephone can be used by the general public instead of being confined to the actual subscriber, with the result that in many towns every shop or place of business which has a telephone becomes in practice a public call office.

Such a system, Mr. Preece is convinced, would be equally successful in this country, and go very far to extend the telephone service to almost every class. It would, of course, be opposed by the subscribers on the existing system, who, at present, almost monopolise the service, and pay a small price for the large number of messages they can send. The National Telephone Company, Mr. Gaine stated, has already realised the force of this opposition, but it is clearly not one to which a municipality or the Post Office starting operations in any area for the first time would be exposed.

In addition to the general objections to the existing system, there are other reasons connected with the practical monopoly of the National Telephone Company which lead us to believe that, under present conditions, the service is not likely to become cheaper or more generally developed.

1. Mr. Forbes, chairman of the National Telephone Company, stated to the Committee of 1895, that at the date when the rival companies had been absorbed by the National Telephone Company, "the total amount of money spent in the actual construction of the thing was £1,813,000; the amalgamation value and purchase value (those are the figures I read to you) was £3,105,000. The difference (what some people are pleased to call the water value) was £1,292,000."

About £300,000 was paid for patents, which expired in 1891.

It is difficult, of course, to ascertain exactly the difference between the actual cost of constructing the system and that cost plus the amount spent in buying out competing companies, or purchasing useless plant and licenses and patents which have now come to an end. Nor is it clear how much has recently been spent from capital on replacing the single wires by the metallic circuit system in most of the larger provincial towns. It is evident, however, that the service has cost the company much more than it would now cost to replace it by a system at least equally good. This increased cost must naturally involve either a decreased dividend to the shareholders, or increased rates to the subscribers. The dividend has hitherto averaged about 5 per cent.

2. The license of the company expires on December 31st, 1911, and the Committee of 1892 recommended that it should not be renewed. The Post Office is under no obligation to buy even the plant of the company at that date, and the Post Office alone could find a use for such plant should all licenses alike be terminated in that year. It is hardly probable that any Government will give the prescribed notice to purchase not only the plant, but the goodwill, by arbitration, in 1904—a step which was not taken under somewhat more promising conditions in 1897. But the company, unlike all similar monopolies, has power to charge what rates it chooses; and in view of the comparatively small amount already placed to reserve, and the short period for which its license will run, it is evident that, in order to recoup its great expenditure, the present high rates of the company may soon be still further raised. They affect, no doubt, a comparatively rich section of the community, who probably receive full value for their subscription to the practical exclusion of the non-subscribing public. But any further raising of the rates, besides stopping the growth of new subscriptions, would inevitably produce complaints from all sides of the increased dearness of a service which becomes daily more vital to the trading interests of the country, and a public demand might in consequence arise for the Government to undertake the service itself. Unless the Government had already an alternative plant available, supplied wholly by the Post Office, or partly by municipal licensees, the purchase of the company's undertaking at an inflated price might thus be imposed upon the Government. The inducements to the company to produce such a result are obvious, and your Committee cannot too strongly recommend that no delay

should occur in taking adequate precautions to prevent it. Mr. Preece informed your Committee that it would probably take five years to provide such an alternative plant for the whole country.

3. Under the peculiar conditions (or freedom from conditions) of its license the company has an obvious reason for limiting the number even of its subscribers. As subscribers upon an exchange increase, the cost of the service increases so much, that a point is at last reached at which an increased number of subscribers fail to repay the additional cost. The company, unlike the Post Office, from whom it receives its license, has power to refuse service, and thus to pick and choose its subscribers, and thereby to limit their number, and in doing this it is materially assisted by the grant of extensive areas, which afford it a wide choice of the most remunerative subscribers, and at the same time go far to protect it against competition.

As the number of subscribers on an exchange is thus restricted, the number of exchanges within an area must, in consequence, be increased. The cost of thus sending a message through two or three exchanges and over the junction wires has, of course, to be paid for by somebody, and it is paid for in the disguised form of a larger annual subscription. Under a scheme of smaller areas than those which have in fact been allotted to the company, the wires which connect such exchanges would, in most instances, have been Government trunk wires, directly producing a revenue to the Post Office.

4. Mr. Forbes stated to your Committee that, owing to the necessity for the company to recoup its expenditure before 1911, it would probably not extend its operations into new districts after 1904, and in reply to the question, "Do you mean to say that after 1904 you will refuse all new subscribers?" said, "I think it is highly probable." It is possible that even an earlier date might have been named. What is thus true of rural districts is probably true also of many urban districts not yet supplied with exchanges, and is possibly applicable even to extensions of the service in the areas already thus supplied. Mr. Gaine, indeed, added in his evidence that in no fewer that 106 areas already assigned to them the company has no exchange, and, though an active canvass had been undertaken, in some not one subscriber. It is not evident why such areas were assigned to the company before any public demand existed, and it is difficult to reconcile the fact stated by Mr. Gaine with the evidence of Mr. Lamb, second secretary to the Post Office, to the effect that areas were created only as the public required them, and that, so far as he knew, no area had been created which did not contain an exchange.

5. Another serious difficulty is the question of wayleaves. Underground wayleaves are stated by the company to be a necessity of an efficient service in urban districts. Between post offices and exchanges, and from exchange to exchange, underground wires are laid by the Post Office and rented to the company, and, as regards wires between two exchanges, in the case of towns of a population exceeding 30,000, the Post Office is bound by its agreement to provide and lay them down if a price can be agreed on with the company. Even to these, however, objections are raised by many municipalities, who complain that it is an abuse of the special powers of the Post Office to assist a private company to disturb the public streets. So far as regards those wires which connect exchanges with a post office, such a proceeding is fully justified by considerations of the public interest. As regards those between two exchanges the justification is less obvious, although no doubt such an arrangement is in accordance with the terms of the agreement. The legal right, however, of the Post Office to enter into such an agreement is disputed by some of the large municipalities. The Post Office has not exercised the statutory powers which it claims to lay underground communication for the company between the exchanges and subscribers of the company. All municipalities can refuse their consent to such wires being laid by the company itself, and many have, in fact, done so. Yet it is just these wires which are declared by the company to be a necessity for any effective service. The service hitherto given has been conducted chiefly by overhead wires, and for these the company has been generally able to get wayleaves, though at times, in order to obtain these, it has had to resort to the peculiar power it possesses of refusing service, except where onerous conditions are agreed to. This power does not appear to your Committee to have been always used in a satisfactory manner, and the conditions attached to the agreement have in many cases misled subscribers. Parliament has repeatedly refused to extend the wayleave powers of the company, and it does not appear likely to grant them now.

More serious than the difficulty of obtaining new wayleaves in the future is the precarious tenure of those which already exist, overhead and underground alike. Mr. Gaine gave evidence to show that out of 143,000 miles of the company's wires, 120,000, or about five-sixths, are liable to be removed at short notice of six or 12 months.

Even the underground wayleaves between exchanges and subscribers granted by local authorities, and which exist mainly in certain large provincial towns, where special agreements have been come to with the company, are liable to be terminated in some cases after 12 and in others after six months' notice. The Post Office has for some time past granted the use of underground wires between its local offices and the exchanges, or between two exchanges in various large towns, but no binding arrangements have yet been made, and Mr. Lamb stated that even the draft agreement had not yet been submitted to the company.

In the opinion of your Committee the service given by the company, though not generally inefficient, is inadequate. For the class of subscribers who have a right of unlimited user, and whom almost alone the company serves, the rates cannot be considered unduly high, though higher than are paid by similar subscribers in many Continental countries, but to the large majority of the public who only require a limited user the rates are prohibitive.

We think that a service already so essential to commercial men, and so well calculated under other conditions to benefit directly or indirectly all classes of the community ought no longer to be treated as the practical monopoly of a private company, a course for which no legal or moral necessity appears to exist, and especially ought not to be worked on a system and under conditions which confine its benefits to a limited class in selected areas, permit preferential rates to be charged, and allow a private licensee of a public monopoly to refuse the use of a business necessity to one tradesman and grant it to his competitor under similar circumstances, impose no limitation of charges, and leave the public at large dependent on a service which is in its turn wholly dependent upon innumerable wayleaves held upon very precarious tenure, and nearly all liable to be terminated after six or 12 months' notice.

II.

We had next to consider whether municipal and other local authorities should have power to undertake a telephone service, regard being had to local finance. Your Committee, however, felt bound, before dealing with this question, to fully satisfy themselves that the Post Office is not prevented, either by legal agreement or by good faith, from limiting or ending the monopoly of the company.

On the right of the Post Office to compete in any area, either itself, or by means of licensees, the written agreements between the Post Office and the company are distinct and unmistakable. But in the evidence given before us, Mr. Forbes endeavoured to insist on verbal understandings which he alleged to exist, restricting the evident meaning of the written contracts.

This in contradiction with the evidence given by him in 1895.

In 1892 Mr. Lamb gave the following evidence before the Select Committee on the Telegraphs Bill:—

"(Q.) 114. Is there any understanding that the Post Office will not compete with the companies in these areas?—(A.) No; under the existing license it is expressly reserved that the Postmaster-General can either give a license, or may himself carry on the business; and that is to be a distinct part of the new understanding." "(Q.) 115. The minute says: 'The Department holding itself ready to comply with the reasonable demands of any town or district.' Supposing it were maintained that there were already reasonable facilities given by the company, would it still be open to the Post Office to compete?—(A.) Yes, that would be distinctly reserved."

In 1895, Mr. Lamb gave further evidence before the Select Committee on Telephones. In answer to Sir Charles Cameron, with reference to Clause 18 of the proposed Agreement, he said, (Q.) 259. "There is no doubt the Post Office could, without any breach of honour or contract, grant additional licenses."

"(Q.) 260. Or faith?—(A.) Or faith; there is no doubt about that."

Before the same Committee Mr. Forbes himself was examined, as follows, as to this evidence:—(Q.) 4,643. "Mr. Lamb, whom we examined, or who was a witness on behalf of the Post Office, said (I think I can almost quote his own words) that the Post Office was certainly not in law, on the strictest interpretation of the agreement, in any way debarred from granting competing licenses, and that it was under no obligation, even in honour, not to grant competing licenses?—(A.) I believe they are absolutely free. (Q.) 4,644. You agree with him that there is not even an honourable engagement on the part of the Post Office not to grant competing licenses?—(A.) The Post Office are absolutely free. I will go a little further, and say that in all the negotiations (which were prolonged) there never was the slightest suggestion, directly or indirectly, of any such cession on the part of the Post Office of a promise or pledge to lock up their own discretion."

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

16,679. "Improvements in cut-outs for high voltage electric currents." H. M. Darrah. Dated August 2nd.

16,706. "Improvements in electric supply meters." E. Wilson. Dated August 2nd.

16,714. "Improvements in systems of electrical distribution." The British Thomson-Houston Co., Ltd. (C. P. Steinmetz, United States.) Dated August 2nd. *(Complete.)*

16,715. "Improvements in systems of electrical distribution." The British Thomson-Houston Co., Ltd. (C. P. Steinmetz, United States.) Dated August 2nd. *(Complete.)*

16,716. "Improvements in systems of train control." The British Thomson-Houston Co, Ltd. (E. W. Rice, jun., United States) Dated August 2nd. *(Complete.)*

16,717. "Improvements in trolleys." The British Thomson-Houston Co, Ltd. (F. E. Case, United States) Dated August 2nd. *(Complete.)*

16,734. "Improvements in electric locks and combination mechanism therefor." P. A. Newton. (H. G. Carleton, United States.) Dated August 2nd. *(Complete.)*

16,754. "Improvements in coin-freed apparatus for the automatic delivery of electric current." O. Biebenstein. Dated August 2nd. *Complete.*)

16,771. "An improved electric signalling system." E. B. Merrill. Dated August 3rd.

16,775. "Improvements in and connected with the manufacture of filaments of carbons for electric lamps." J. B. de Alzugaray. Dated August 3rd.

16,807. "Improved methods of controlling and directing electro-deposition of metals and alloys." W. D. Gooch. Dated August 3rd.

16,817. "Improvements in automatically operated electric signalling apparatus for railways and the like." L. Leduc. Dated August 3rd.

16,834. "Improvements in means for the automatically regulated charging of electrical accumulators." C. U. E. Petersen. Dated August 3rd. (*Complete.*)

16,871. "Improvements in coupling arrangements for connecting electric wires." A. Shiels. Dated August 4th.

16,872. "Improvements in electrical signalling on railway trains." A. Shiels. Dated August 4th.

16,875. "Improvements in electricity meters." E. Schattner. Dated August 4th. (*Complete.*)

16,876. "Improvements in secondary electric batteries or accumulators." E. J. Clark. Dated August 4th.

16,883. "Apparatus for heating and cooking by electricity." M. Hansen. Dated August 4th.

16,888. "Improvements in electric bell pushes for communication purposes in railway trains." J. R. Eccles. Dated August 4th.

16,902. "An improved electromotive mechanism for clocks and the like." H. H. Lake. Dated August 4th.

16,938. "A new or improved electric contact making device." H. Bingham. Dated August 5th.

16,947. "Improvements in arc lamps." H. S. Dodd and R. I. Bagnall, jun. Dated August 5th.

16,972. "An improvement in jointing boxes for coupling up and insulating electric wires." T. McEwan. Dated August 6th.

16,973. "Improvements in or connected with electrical conductors and anodes for electrolytic and similar purposes." The General Electrolytic Parent Company, Limited, L. Hargreaves, and W. Stubbs. Dated August 6th.

16,981. "Improvements in and relating to electric wiring for lamp circuits." D. Maxwell. Dated August 6th.

16,999. "Improvements in or relating to electric accumulators." E. Andreas. Dated August 6th.

17,026. "Improvements in or connected with electric meters." H. Reason and The Mutual Electric Trust, Limited. Dated August 6th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co, 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

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2,999. "Improvements in transmitters of Morse telegraphic apparatus for continuous and alternating currents." C. Rossi and P. Torcieri. Dated February 5th, 1898. Relates to improvements in transmitters of Morse telegraphic apparatus for continuous and alternating currents. It consists of a metal plate which is bent to a channel shape and open below, and is placed upon and secured by means of screws to the lever of a Morse transmitter. To this plate there is pivoted a stirrup, one end of which is bent below the lever of the transmitter. A small plate or table of bone, ivory, or other insulating material, is secured to the said stirrup. A spiral spring is secured at one end to the transmitter and at the other end to the stirrup; there is also a contact pin for effecting the breaking of the circuit. 2 claims.

3,569. "Improvements in electrical apparatus for indicating or recording at a distance the positions of an index hand or analogous movable object." A. Custodis. Dated February 12th, 1898. Relates to apparatus for automatically indicating or recording at a distant receiving station the consecutive positions occupied by an index hand on a dial or graduated base plate on which it is pivoted. It consists of a compass needle, which takes the place of an index hand, and underneath it there is mounted a series of contact pieces insulated from each other. They are supported by a ring insulated from the same by a ring of ebonite. The metallic ring is connected by means of arms, with a collar mounted on the axle of the compass needle, and situated underneath the ring from each of the contact pieces, a separate wire leads to the receiving instrument, which contains a separate electromagnetic for each wire within the circle of contact plates is mounted a concentric contact ring, from which a conductor leads to one pole of a battery connected at the other pole with parallel conductors. 2 claims.

4,435. "Improvements in electric signalling apparatus for use on railways." C. S. Davy. Dated May 18th, 1898. Relates to improvements in electric signalling apparatus for use on railways, and is designed to provide an improved system of signalling by means of electric bells. It consists in the arrangement at suitable distances in advance of each signal, a short bar which is adapted to be depressed by the flanges of the wheels of the engine and train. This bar has inclined ends to graduate the force with which the flanges strike it and to diminish the shock of its rising movements as they leave it. The bar is carried by short lever arms suitably mounted on or near the rail, and is normally kept in its raised position, flush with the rails, by a counter balance weight or other suitable means. 3 claims.

7,423. "Process for the extraction of pure metals or metallic alloys and the production of carbides by electric heat." H. Aschermann. Dated March 25th, 1898. Relates to subjecting to electrical heating a mixture of carbon with an oxide and a sulphide of metals having different affinities for the carbon. If, for example, a mixture of iron, lime, and carbon is treated in the ordinary electric furnace, metallic iron is obtained on one side; on the other side carbide of calcium. 1 claim.

10,585. "Improvements in electric resistances." W. P. Thompson. (The Chemisch-Elektrische Fabrik "Prometheus" Gesellschaft Mit Beschrankter Haftung.) Dated May 7th, 1898. Relates to electric resistances formed of a metallic coating burned on a suitable insulating material. For the insulating material lace or varnishes, such, for instance, as superfine copal varnish, are used, which do not carbonise at the temperatures at which the metallic lustres or enamel colours are deposited. As metallic coatings, that is, as resistance layers, there are employed layers of precious metals which in turn are burnt on the above-mentioned varnish layers in the manner of porcelain decoration. The hard copal varnishes employed are firmly burnt on to the metallic surfaces employed (cooking vessels, &c.). In order to attain this object the varnish is spread several times with a brush on the surfaces, and after each application fired in an oven of about 250° C. 1 claim.

11,438. "Improvements in electrical furnaces." Siemens Bros. and Co., Limited. Dated May 19th, 1898. If electrical furnaces are so constructed that the outer air can penetrate to the electric arc, several disadvantages arise. Firstly, the consumption of the carbon electrodes; secondly, if a combustible gas, such as carbonic oxide, is produced in the electric arc, this gas, in entering into combustion, penetrates through the layer of material and carries considerable quantities thereof upwards, producing objectionable fumes and wasting the material. According to the present invention these defects are obviated, firstly, by employing a layer of the pulverulent material to be treated of such a depth that neither the external air can penetrate through the same from the inside; secondly, by employing as the upper movable carbon electrode a carbon tube extending up through the layer of material, so that the gases produced escape through the same without entering into combustion. 4 claims.

11,783. "Improvements in and relating to conductors for electric railways." H. H. Lake. (W. Willard.) Dated May 24th, 1898. Relates to trolley rails for use with cars carrying electric motors. The peculiarity of the rail lies in the fact that the portion of it with which the trolley or shoe carried by the car engages is normally out of electrical engagement therewith by means of the trolley, and so supplies current through the trolley to the car motor. The rail is preferably laid midway between the two rails of the track; upon the sleepers is laid in suitable chairs an insulated conductor. The chairs are grooved to hold a pipe which carries the conductor; a strap passes over the pipe and is bolted at each end to the chair which holds the pipe in place. The whole may be spiked or otherwise secured to the sleeper. 2 claims.

12,019. "Manufacture of active material for accumulator batteries." H. Tobler and J. H. Graeber. Dated May 26th, 1898. Relates to the manufacture of an active material of perfect consistency for accumulator batteries. With accumulator batteries as at present employed, red lead is generally employed for the positive electrode, while white lead is used for the negative electrode. These lead compounds, after being mixed with suitable binding materials, are generally stirred up with dilute sulphuric acid to form a paste, which is then applied to the lead gratings and dried, after which the finished plate is formed. In forming there is produced on the positive plate peroxide of lead together with a layer of sulphate of lead, the latter causing resistance and correspondingly reduces the current pressure of the accumulator. This explains the reason why these plates so readily crumble away. According to the present invention these disadvantages are obviated by forming the active material entirely of lead sulphate; in this case the change which occurs during the charging of the cell produces lead peroxide on the anode and spongy lead superficially on the cathode, while during the discharging of the cell the sulphate is re-formed. 1 claim.

12,350. "Improvements in electric alarums." Siemens Bros. and Co., Limited, and J. Ebel. Dated June 1st, 1898. Relates to electric alarums, so arranged that a striker makes double strokes on a gong in approximately uniform succession for a certain time. It consists of a solenoid coil wound on a non-magnetic tube, within which an iron tubular core is free to slide. Within the core is a helical extension spring having one of its ends fixed to one end of the core and its other end passing through a hole in the other end of the core, and fixed to a bracket on a non-conducting base on which is also fixed the solenoid and the gong. When the solenoid is excited by an electric current, the core is drawn in and its one end strikes the gong; when the current is interrupted the spring causes the core to fly back and strike the opposite side of the gong. 1 claim.